ENGINEERING NEWS

SOME very extraordinary and on its face discreditable testimony as to the management of the Croton Aqueduct tunnel was brought out last week in the legislative investigation, which has been temporarily or perhaps permanently suspended. This not being a daily newspaper, which is bound to spread news whether it is correct or not, and having a preference not to print a thing at all rather than do possible injustice to individuals when only one side has been heard, we have withheld all summary of the testimony until we can do so with greater command of all the facts. In the meantime Gen. NEWTON has come out with an unofficial statement on the other side. What has been brought out so far certainly has a queer look in some of its details; but it is at least conceivable that it may all be explained as consistent with proper and honest management, and therefore we have declined to present it piecemeal.

M. DE LESSEPS grows more rash with time. Not content with the vague prophecy which we quoted last week, that the Panama Canal would be opened " in 1890", he declared on June 19 at a banquet in honor of the President of Ecuador, at which many prominent officials were present, that "the Panama Canal will be completed within two years", which means presumably before June 19, 1890. We shall not be at all surprised if the work on it is completed—all that is ever done—before that time.

THE *Courier des Etats Unis*, and perhaps other American papers advertise the new lottery, $80 bonds being offered at $72, payable through the lottery or at 400 fr. within a maximum period of 99 years. Subscriptions will be received only up to June 26, so that very prompt application must be made after receipt of this issue. Interest is $3 per year. $678,000 per year, with 12 prizes of from $20,000 to $100,000 will be drawn up to 1913, and $440,000 per year after that, as also repayment of the bonds by lot. The first drawing is to be Aug. 16. Subscribers must pay $4 down, $8 on receipt of the certificates, the balance of $60 in partial payments as called within 15 months. An interesting point about the loan is that the authority is to issue $144,000,000 worth. It is proposed, if we understand the matter, to issue 2,000,000 bonds at $80 par and *sell* them at $72, netting (if sold) the authorized amount of the loan, there being a proviso that if the terms of the authorization are violated it may be cancelled. Whether this comes within the law we cannot say. It would seem that the intended limitation must have been on the amount of debt incurred and not of cash received.

THE Nicaragua Canal enterprise gets a good send-off in the Republican platform, which reads:

"Professing adherence to the Monroe doctrine, the present administration has seen with idle complacency the extension of foreign influence in Central America and of foreign trade everywhere among our neighbors. It has refused to charter, sanction and encourage any American organization for constructing the Nicaragua canal, a work of vital importance to the maintenance of the Monroe doctrine, and of our national influence in Central and South America; and necessary for the development of trade, with our Pacific territory, with South America and with the islands and further coasts of the Pacific ocean."

Who is responsible for the non-action on the application for a national charter of the Nicaragua Canal Co. we cannot undertake to say, but as they ask nothing but a charter, and no financial aid or guarantee, we entirely sympathize with the demand that they should have it, and hope they will before Congress adjourns. It will make a good deal of difference in floating loans for the enterprise.

THE dividends of the Suez Canal are beginning again to increase, and with them the price of shares. The ordinary shares of $100 sell now in Paris at $434 and in London at $427.50. The dividend now declared for the year is $15.64 which includes the 5 per cent. interest. The excess dividend of $10.64 is considerably larger than that of the last two years, though it falls considerably short of the return in the fat years from 1883 to 1885 inclusive. The last two years have been unfavorable to the canal in many respects, the number of ships passing through having shown a striking decrease as compared with the years immediately preceding. Fortunately, the returns of this year, show a recovery which promises to put the shareholders in a much more favorable position.

The dividend is equivalent, at present prices, to between 3½ and 3¾ per cent. It is only within the past few weeks that any very marked upward movement has taken place in the shares—which were quiet in the earlier weeks of the year—in spite of the reassuring character of the traffic receipts. For the four months of the year the returns are more than $400,000 better than they were last year or the year before, and are $100,000 better than in 1883, which represented the high-water mark of the canal's receipts.

THE Manchester Ship Canal Co. has a bill before Parliament providing for certain alterations in the plans which give 114 acres of water space, against 100 in the old scheme; the quay space being 152 acres, against 83; and the quay frontage 5⅛ miles and 4 miles respectively. There is thus a large increase in the accommodation provided, while the cost is reduced by $115,000. There are now 56 steam excavators, 73 locomotives, 2,367 wagons, 50 steam cranes and 79 miles of railway track; 6,000 men are employed. The excavation for May amounted to 1,009,052 yds. of earth and 21,371 cu. yds. of rock. The contractor, Mr. Walker, has 48,000,000 cu. yds. of excavation, or about 1,000,000 cu. yds. per month of contract time; this rate is being exceeded and it is expected to excavate 2,000,000 cu. yds. per month very soon.

THE most serious railway accident of the week, was the derailment of a freight train June 16 on the Maysville & Big Sandy road near Maysville, Ky. A switch had been left open and the engine and 14 cars were derailed and wrecked. Two men were seriously injured.——An accident occurred June 10 on the Ohio & Northwestern road, near Batavia, O., which should serve as a warning to some other roads. The road was originally narrow gauge, but was widened to standard gauge about a year ago, and the old light rails were retained. The rails naturally "spread" and an engine was derailed, but fortunately without serious results.

IN regard to this accident we quote the following from a local paper:

"When you try to run heavy standard-gauge locomotives and heavy standard-gauge coaches over narrow-gauge rails, such accidents are very liable and very often do occur. It strikes us that the O. & N. W. authorities are standing in their own light every day they delay the replacing of this 34 mile stretch with heavy steel rails. There is certainly no economy in the slow time, the delays and the liability to mishaps that this light iron occasions. It requires (within about 12 minutes) the same length of time to make this 34 miles that it does to make the run of 68 miles, twice the distance, from Sardinia to Portsmouth over the heavy steel rail. There is no economy in using light iron on a standard-gauge road."

THE following bridge accidents are reported: On June 11 a double header freight train on the Mexican National Railway, broke through a long trestle across an arroyo, between Morales and Salinas, which had been weakened by a flood. The two engines and 11 cars went into the water; two men were killed and three injured.——On June 11 a bridge on the Burlington & Missouri River Railroad near Brush, Col., 90 miles from Denver, was destroyed by fire.——On June 13 a highway bridge near Chatfield, Minn., was carried away by a flood caused by the washing out of a mill dam.——On June 15 a trestle near Sheldon, Vt., on the St. Johnsburg & Lake Champlain Railroad was washed away. ——On June 16 the bridge at Rockport, Ky., on the Newport News & Mississippi Valley Railway, gave way under a freight train. The train had crossed the draw and was on the west side of the main structure, when a portion gave way, throwing the entire train to the ground, and the engine and 5 cars rolled down the bank into 30 ft. of water. The bridge was a combination bridge. Five men were fatally injured.

THE storm of June 15 caused washouts on the St. Johnsbury & Lake Champlain near Sheldon, Vt.; on the Missisquoi road near Sheldon Springs, and on the Central Vermont near East Swanton.

MR. CUNNINGHAM, of the Canadian Society of Civil Engineers, in discussing a paper by Mr. WALLIS on Railway Accidents, made the following remarkable statement:

"Few people, who have not paid special attention to the subject, have any idea how much particular kinds of soil heave with the frost. The writer has seen a point in Prince Edward Island, where it was necessary to "shim up" the rail 11 ins., in order to take out inequalities caused by the frost. The island soil is unusually troublesome in this respect, and this was on a part of the Island Railway where there was, practically speaking, no ballast."

The "island soil" is certainly unusually troublesome in this respect. We have heard tall shimming stories, and seen cause for some, but never anything quite equal to this.

A PRESS dispatch says that a cyclone of great severity swept over the city of Granada, in Nicaragua, on June 2. The heavy rains inundated the southern portion of the city, destroying several houses and a portion of the railway track.

THE union depot at Portland, Me., will be opened for traffic June 25, although there is considerable finishing work yet to be done. The building is of granite supplied by the Maine & New Hampshire Granite Co., and has a clock tower 128 ft. high. The iron train shed is 500 ft. long. This depot will be used by the Maine Central, Boston & Maine, and Portland & Ogdensburg railways. It is owned by the Portland Union Railway Station Co., of which Hon. ARTHUR SEWALL, President of the Maine Central Railroad Co., is President. WILLIAM A. ALLEN is chief engineer, and the architects of the structure were Messrs. BRADLEE, WINSLOW & WETHERELL. The station was built by JAS. CUNNINGHAM, of Portland, and the train shed adjoining by COFRODE & SAYLOR, of Philadelphia. The cost of the entire structure will amount to several hundred thousand dollars.

AT a meeting of the Board of Street Openings and Improvements of New York City for the consideration of the Elm Street improvement at which all the members were present, the arguments of eight representatives of property owners interested were heard, seven of which were favorable to the proposed improvement. The route most favored was the most direct one proposed, which would extend through the blocks at the head of Elm Street at its intersection with Marion at Spring Street, to the junction with Lafayette Place at Great Jones Street. The new thoroughfare to be 80 or 100 ft. wide.

Definite action was postponed until the approximate cost of making the proposed improvement could be ascertained.

THE location of the first lock and dam in the Cumberland river has been fixed just beyond Nashville. The lock will be built first and work will in no event get to the dam during the present season. The dam will create a slack water pool to a point fifteen miles above the city, where the second lock and dam will be placed.

The improvements will consist of a series of these slack water pools to the number of twenty. The river itself will be used as the canal and the locks are to be placed at the dams.

The estimate for the whole work is $4,000,000, and at the present rate of $200,000 a year, it will consume twenty years. The Muscle Shoals improvements have taken twelve years, and will need one more season's work. They have cost the Government about $3,000,000, or about $300,000 a year. The work now to be undertaken in the Cumberland is a much larger enterprise, for the reason that it requires a greater number of locks, the Muscle Shoals having eleven.

THE plans and specifications for an electric railway line 3 miles long for Pullman, Ill., have been completed, and the contract let. The Van Depoele overhead system will be used and the cost is estimated at $100,000. The road will probably be in running order by September.

Standard Trestle Plans, Norfolk & Western Railroad.

The standard plans which we illustrate differ in many important details from the more common designs, but will be generally admitted to have some very good points, and we are informed that they are rendering most excellent service in practice.

There are but few localities now where timber structures so high as 125 ft. are used at all, the preference being rather for iron viaducts. When they are to be used, however, the plan given affords excellent bracing both transversely and longitudinally, deficiency in the latter being a too common defect in structures of this class. The bents being 25 ft. between centers, the girts (4x12) and longitudinal braces (8 x 12), especially the latter, seem rather light for sticks of such great length, but they make up by their number for any deficiency of section, and are plainly intended to act chiefly in tension. The sway-bracing is also abundant and in connection with the three parallel batter posts should give great transverse stiffness. A defect of the structure, and in our judgment a very serious and unnecessary one, is the use of mortises in the sills, making it impossible to renew defective sticks. Split sills, similar to the split-caps, would give at least equal stability and be open to no such objection. It will be observed that both the batter posts and plumb posts are cut, and connected by a butt joint only, at each story, trusting to the "intermediate caps" or girders for stability. This construction is somewhat unusual, and seems at first sight objectionable; but the fact that it gives a very stiff structure in practice is after all the important one. Figs. 3 and 5 show the manner in which the 25 ft. spans are reduced to 12 ft. 6 ins., at the end.

Whether it is really better to use 25 ft. spans with the central straining-beam style of supporting the stringers, or 15 ft. or 16 ft. bents without it will be questioned, especially as respects the lower structures. It certainly takes less material both in the bents and in the floor. The floor seems to us the weakest point in this design and unduly light. The contingency of a failure in one of the straining beam braces is certainly one to be considered, and four 7 x 15 stringers would make sorry work of carrying a locomotive over even once, especially as they do not break joints but are only one bent long. The ties, likewise, are shorter and spaced further apart than we believe to be good practice, and without placing guard-rails and re-railing guards at each end of the structure make a floor which certainly should not be regarded as safe for a long structure. We are not informed as to whether the floors are so protected, but the natural man seems to so abhor derailments that he abhors a floor solid enough to carry a derailed car.

A specially excellent feature of these trestles is the solid masonry footing for them. It is not always possible to obtain stone for such masonry in the West, but wherever it can be had it is poor economy indeed to found a trestle on shaky "mud-sills", as is often done, and only a little better to use piles, which are sure to rot before the rest of the structure. Whether this form of trestle is really to be preferred to the "cluster bent" type, built up of 8 x 8 sticks breaking joints with each other, is a question which we will not now discuss. We can see a good many reasons why either might be preferred, but this is the simpler and cheaper, and it may well be the stiffer likewise.

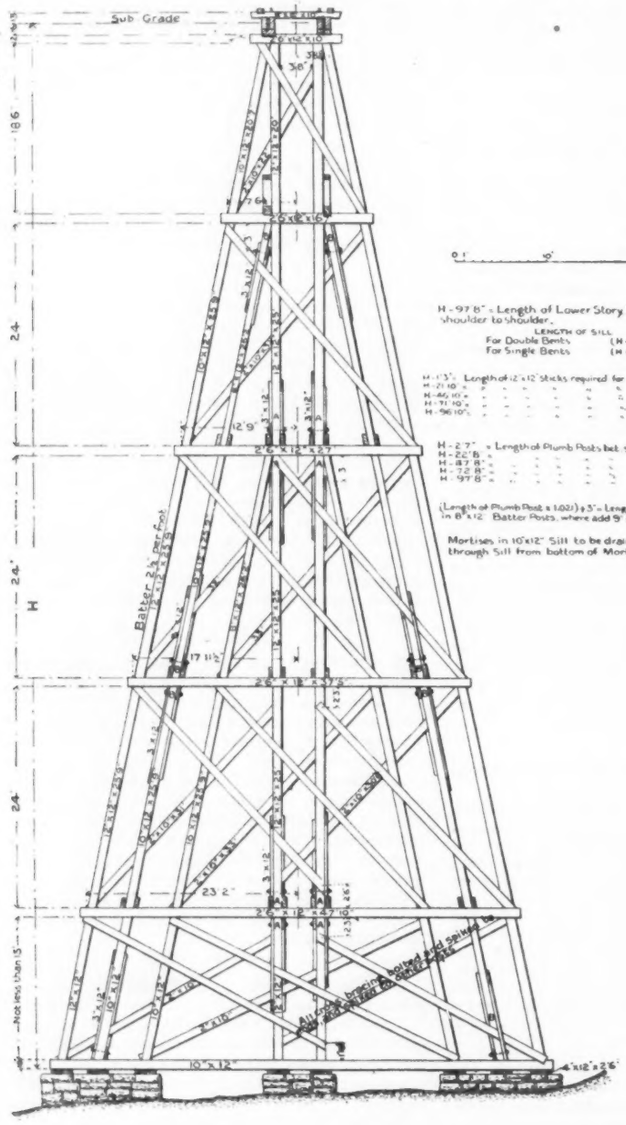

Sub Grade
H - 97.8" = Length of Lower Story Plumb Posts, shoulder to shoulder.
LENGTH OF SILL
For Double Bents (H+24)+7'11"
For Single Bents (H+24)+8'1"
Mortises in 10"x12" Sill to be drained by Vertical Hole bored through Sill from bottom of Mortise
Batter 2½" per Foot
Not less than 15°

Fig. 1.

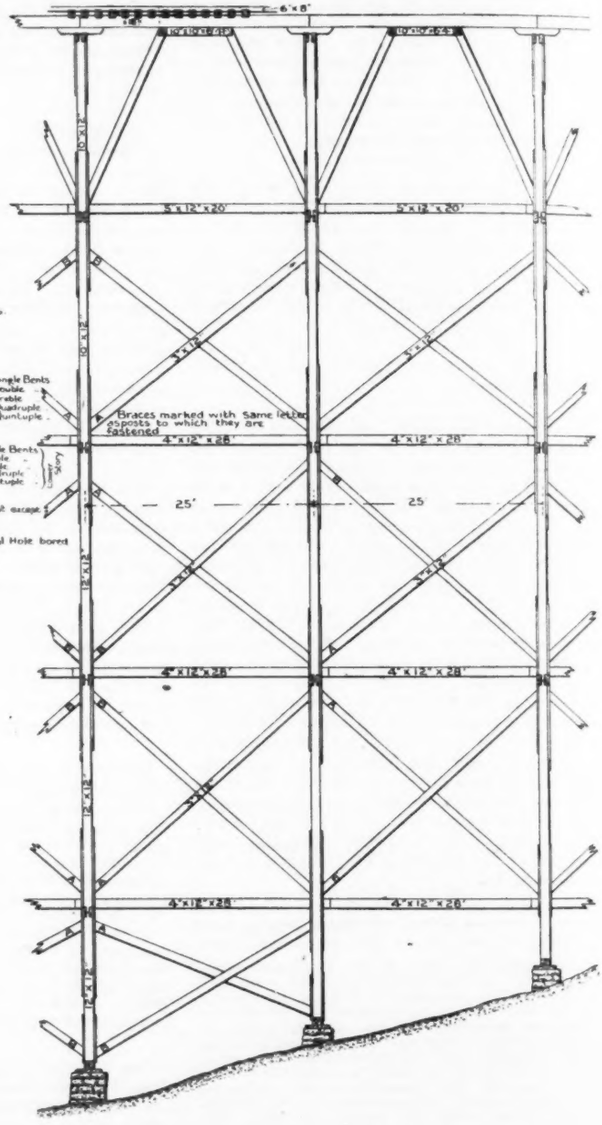


Fig. 2.

Standard High Trestle, Norfolk & Western Railroad, W. W. COE, Chief Engineer.

London Street Names.

The London *Financial News* is taking up the question of a better system, of street names, or rather it points out the inconvenience resulting from the existing system or want of system. While recognizing the appropriateness of titles of historic origin, such as Aldgate, Aldersgate St., Fleet St., Covent Garden, Bunhill Row, Holywell St., etc., it deprecates the use of such titles for new streets where they have neither sense nor significance. It also ridicules the constant use of high sounding names such as Belgrave Place, Wilton Crescent, etc., in new suburbs, and mentions a "Ruddygore St.", as an instance of absurdity.

"The foolish manner in which the names of streets in London have been duplicated is so well known that it hardly needs mention. Of the true number of 'Union' streets, 'George' streets, 'John' streets, 'New' streets and 'Queen' streets, no one but the omniscient postal authorities can form any idea. There may be found within

12 miles of Charing Cross the following repetition of names:—Churches, 46; Chapels, 23; Kings, 26; Queens, 15; Charles, 31; Johns, 19; Georges, 26; James, 20; Williams, 16; Dukes, 13; Unions, 25; besides many Oxfords, and Cambridges, Southamptons, Bedfords, Princes and Russells. These names stand independent, but in other parts will be found additions to them, viz.: Lower, Upper, Great, Little, New, Old, East, West, North and South.

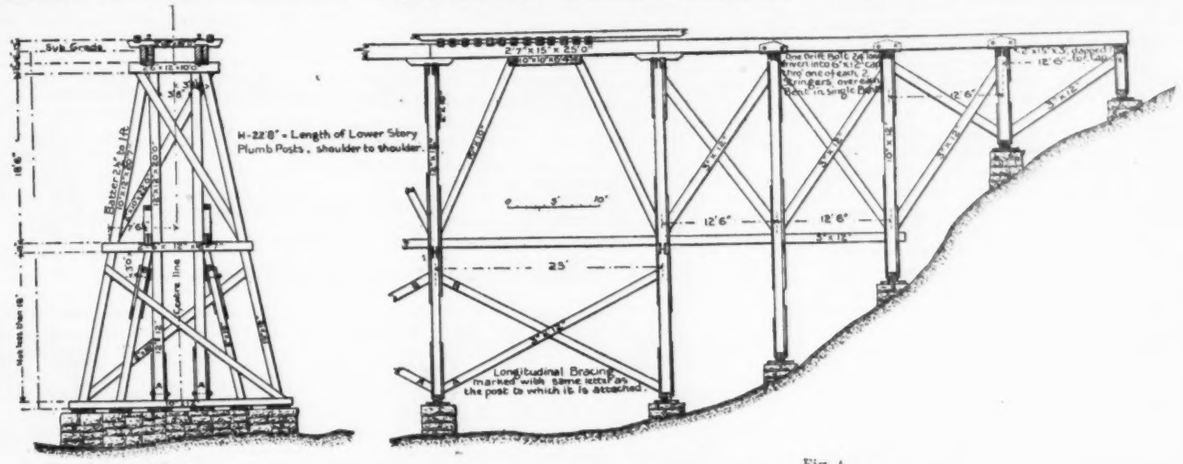

Sub Grade.
H-22'8" = Length of Lower Story Plumb Posts, shoulder to shoulder.
Batter 2¾ to 1ft
Center line
Longitudinal Bracing marked with same letter as the post to which it is attached.
12'6"
25'

Fig. 3. Fig. 4.

Standard Two-Story Trestle, Norfolk & Western Railroad. W. W. COE, Chief Engineer.

There are 90 Littles, 50 Greats, 70 Uppers, 20 Lowers, 77 News, 18 Olds, and above all, 134 Saints prefixed to such as John, James and Thomas. We own the richest and most adaptable language in the world. In naming our streets and places, let us no longer use the language to confuse and obscure, but to instruct and enlighten."

The English, French and Russian Navies.

The Engineer publishes an elaborate article of an alarming tone on this subject beginning in this concise and taking manner:

"If the whole of the guns afloat in British armor-clad vessels were fired, the muzzle energy of their projectiles would be sufficient to lift the combined French and Russian armored fleets bodily 7¾ ft. out of the water.

Similarly if the whole of French and Russian guns behind armor fired, their energy would be sufficient to lift the British armored fleet 7¾ ft. out of the water. Reager, this statement is fairly correct, but the contingency contemplated is not likely to happen. We have opened with these sensational statistics to call attention to figures which we proceed to go into in a more business-like manner."

It then proceeds to go into details, from which we are amazed to find that the American navy is left out of account as if it amounted to nothing, even after our recent additions, and publishes the tables in much detail which we greatly abridge as above:

THE NAVAL ARMAMENT OF ENGLAND, FRANCE AND RUSSIA.

	England.		France.		Russia.	
	Total wt. Tons.	Total energy Foot-tons.	Total wt. Tons.	Total energy. Foot-tons.	Total wt. Tons.	Total energy Foot-tons.
Protected guns of all classes.....	9,397.0	3,637,000	6931.5	2,758,737	3163.4	949,020
Unprotected guns "	4,140.8	2,218,245	2686.8	1,069,346	539 4	161,820
Grand total of guns.....	13,537.8	5,855,245	9618-3	3,828,083	3702.8	1.110,840
	No.	Total wt.	No.	Tota' wt.	No.	Total wt.
Heavy guns behind armor.....	611	7,619	210	6,020	68	2,038
Total " " "	706	9,397	517	6,932	236	3,163

The *Engineer* summarizes its main conclusions as to what its facts show as follows:

"Let us see practically what is our gun power compared with France. We have considered the grand total of all our guns afloat to show how far we were making guns for all purposes; but let us now take only those of our armored fleets, the British guns weighing 9,397 tons, and the French 6,931 tons, the relative proportions being nearly the same as that of the total guns afloat of each nation. These have approximate total energies of 3,637,000 and 2,758,737 ft.-tons respectively. These figures represent roughly the armored artillery power of each nation—that is, nearly in proportion of 4 to 3. If Russia's ironclads be thrown in with those of France we have to add 3,163 tons of metal and 949,020 ft.-tons energy, making the total of 10,095 tons of metal and 3,707,757 ft.-tons energy—that is, *the French and Russian guns combined are more powerful than the British.*

"The fact that this energy does not appear capable of producing so much effect on the British fleet as our own fire produces on the combined French and Russian, as stated in the commencement of this article, is merely due to the circumstance that the tonnage of our vessels is the greater.

The Engineer then points out that the foreign fleets are increasing much faster than the English, and adds:

"The Russian fleet is by no means a strong one; it is very unsatisfactory then to find that its added strength is sufficient to render the French our match, particularly as we have so many colonies to defend all over the world, and worse than all, have the fatally weak element of a gigantic commerce. The defence and attack of this latter naturally draws us on to the consideration of the guns of unarmored ships. The total weight and energy of the guns of these, are, for Britain, 4.141 tons with 2,218,345 ft.-tons energy; France 2,687 tons with 1,069,346 ft.-tons energy; and Russia, 539 tons with 161,820 ft.-tons energy. The energy of the French and Russian guns combined, namely, 1,231,166 ft. tons, is not much in excess of half that of the British guns, but it is sufficient to destroy our commerce, and with it to threaten our national existence, for the excess of our ships is not at all adequate to checkmate attacks made in all parts of the world. The most hopeful idea is to armor merchantmen efficiently, and for this we need guns. The more then this question is looked at, the more we feel satisfied it will be felt that our great need is guns afloat. In the meantime our field artillery with their now obsolete guns are crying out for a field piece of really new type. Our siege trains are no better supplied, and it is idle to talk of our ports. Then, again, except a few old type Woolwich guns very well converted in their way into mortars, we have no rifled pieces for vertical fire. How shall we get our guns? How overtake the four years we stood with our hands in our pockets? Without exaggeration, and with every wish to take the most sober and reasonable view of matters, is it not high time to ask this question?"

Americans should duly appreciate their blessings in not having to worry much over such questions as these.

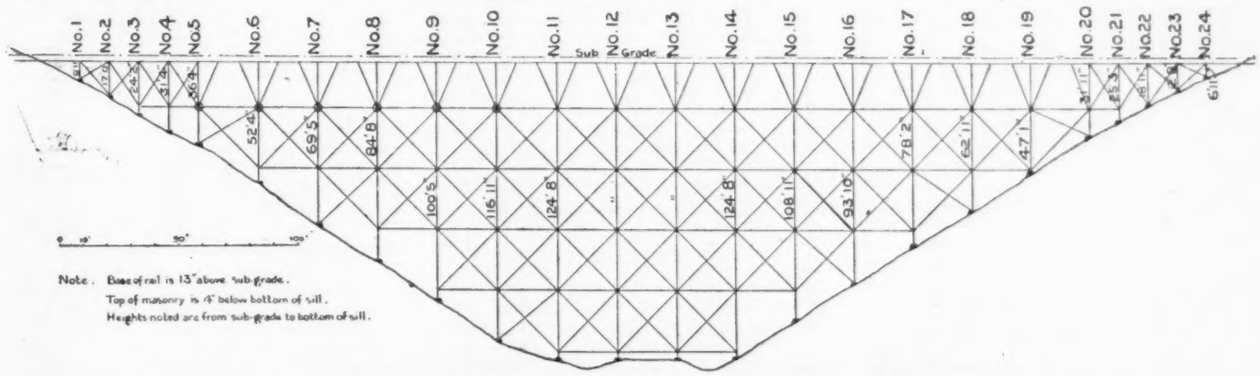


Fig. 5.—General Arrangement of High Trestles, Norfolk & Western Railroad.

Telegraph and Telephone Sub-Ways in England.

Mr. ALBERT R. LEDOUX, at the close of an excellent article in the *Evening Post* on English and Continental practice in this matter, summarizes European practice as follows:

The whole situation to-day in Europe, including Great Britain, may be summed up as follows:

Telephone service; over head, small coppper wires on neat standards upon housetops, owners compensated for use of roof. Poles only allowed where roof service is impossible.

Telegraph service; largely under ground in England, and on housetops elsewhere.

Electric (arc) light service practically all overhead.

So complex and intricate a tangle as the subway problem in New York is not even dreamed of in Europe, much less solved. With our growing electric-light service, our district-messenger calls, and, above all, our great telephone system; with our network of gas, and water and steam pipes in the street, we have a problem that we must work out practically alone—unaided by European experiences. Radiating from our metropolis, like the threads of a gigantic spider's web, including and connecting neighboring cities and growing towns and even distant cities, already there stretches a network of wires along which throb the impulses of our commercial life. We think the problem of their location difficult to-day; what will it be when every man has a telephone in his house; when gas-light within, as well as without, gives way to the electric light; when our streets must yield yet more room for fuel-gas pipes, larger water-mains, etc., etc.; what shall then be done?

It needs but a brief glance ahead to see that our few iron pipes or any other electric conduits must prove inadequate, and it requires no inspired prophet to predict that we must soon in New York come to the Paris system of sewers, cost what it may, at least on all main streets and avenues, wherein all our pipes and wires can be placed, and digging up the pavements cease.

The last statement gives the pith of the whole situation, undoubtedly, and the sooner we make a beginning in that direction, the sooner we shall be finally rid of this vexatious question.

Personal Injuries by Canadian Railway Accidents.

Mr. A. T. DRUMMOND, in a paper on Railway Accidents, before the Canadian Society of Civil Engineers, makes the following comparison of the accidents per *passenger carried*, a wretched way of making such comparisons, since it neglects the comparative distance traveled. It, beyond question, works unjustly to Canada in the following table, moreover, since the average distance travelled per passenger must be much greater than in most of the States mentioned; but the Canadians have borrowed this bad practice in railway accounting from the English—the only civilized nation from which they could borrow it—and, perhaps, think it would be unpatriotic to improve on it. With this reservation we give the table for what it is worth:

Year	State or Country.	Passengers carried. (with res've)	Killed or Injured.	
			Passengers.	Empl'y's & others
1885	Massachusetts	69,603,700*	74†	443†
1886	"	75,842,581*	107†	476†
1885	Connecticut	17,430,921*	12†	222†
1886	"	19,011,381*	42†	297†
1885	New York	73,555,179*	112	1435
1886	"	81,463,709*	125†	1516†
1885	Ohio	32,895,641*	78	1061
1886	"	31,781,707*	49†	911†
1885	Illinois	20,593,478†	145†	1318†
1886	"	22,727,934	64†	1254†
1884	Michigan	24,782,322*	36†	459†
1885	"	22,970,564*	36†	403†
1885	Canada	9,672,799	84	757
1886	"	9,861,024	79	636

*Includes the total returns of the entire lines of the through railways.

†Includes only returns properly referable to the particular State.

The analysis of the causes of accidents, in Canada, to persons, is for the two years 1885-86, as follows:

	1885.	1886.
Falling from engines or cars	125 (8 pass.)	75 (8 pass.)
Jumping on or off trains	64 (24 ")	65 (16 ")
Making up trains	20	10
Putting head or arms out of windows	3	1
Coupling cars	285	222
Collisions or derailments	97	89
Trespassers on track	153	135
Striking overhead bridges	10	8
Explosions	2	0
Other causes	82	110 (12 ")
	841	715

Is will be observed that injuries due to train accidents are only about one-eighth of the total.

Mr. DRUMMOND then goes on to summarize and discuss the various preventive measures possible, saying much that is true and good, but which it would be only repetition for us to abstract. The paper was followed by an extensive discussion.

The Ceiling of the Assembly Chamber at Albany.

The present status of this work is as follows: To prevent further deterioration of the large groined vault, a square tower of timber was erected in the Assembly chamber several months ago, the supports of which were carried to the foundations, and upon which centers were put, supporting the ribs of the main vault throughout the greater part of their length.

In the meantime a bill has been passed by the legislature appropriating the sum of $278,592 for the purpose of removing the present vault and replacing it by another suitable structure. The character of the latter is to be left to the decision of a committee of five members of the Assembly, the Speaker to be one and the other four to be appointed by him.

A report made in April by a commission of experts recommends the replacing of the present structure by a flat wooden or iron ceiling, in order to reduce the weight thrown upon the walls and foundations, and to entirely remove the lateral pressure on the outer walls of the building.

On Thursday, June 7, Governor HILL gave a hearing in this matter, which was attended by L. EIDLITZ, architect of the Assembly chamber, J. W. EATON, his counsel, J. SMITH, J. MCINTYRE, State Librarian GRISWOLD, and N. W. FABIAN and E. A GIESELER, the latter two members of the German-American Technical Society of New York, whose resolutions in regard to the condition of the vault were published in our issue of April 21, and have been submitted to Governor HILL.

Mr. EATON and Mr. EIDLITZ insisted that the ceiling should not be removed before thorough investigation by competent persons appointed for this purpose. Mr. EIDLITZ claimed that a restoration of the three center vaults and slight repairs to some of the others would be all that was required to complete the structure at a cost of not more than $40,000.

Mr. E. A. GIESELER then said that the construction had been publicly criticized and its ultimate fate foretold by Mr. FABIAN as long as 7 years ago. The vault had been built according to a general design (pointed arches) that had stood the practical test of centuries, because only employed in moderate dimensions. Modern research had shown these principles to be faulty, and had proved the absolute necessity of a new and mathematically developed system of arch lines (parabola), when areas of such unprecedented size were to be covered.

These undisputed results of modern investigations had been ignored in the present structure, and hence its failure.

While the constructive part had to be criticized adversely, it was but just to say that the design was one of great beauty, a grand architectural conception. These features should be retained under all

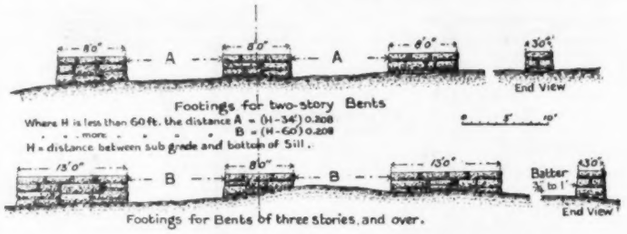

Footings for two-story Bents
Where H is less than 60 ft. the distance A = (H-34') 0.208
H = distance between sub grade and bottom of Sill.
End View
Footings for Bents of three stories, and over.
End View

Fig. 7.—Masonry Footing for Trestles. Norfolk & Western Railroad.

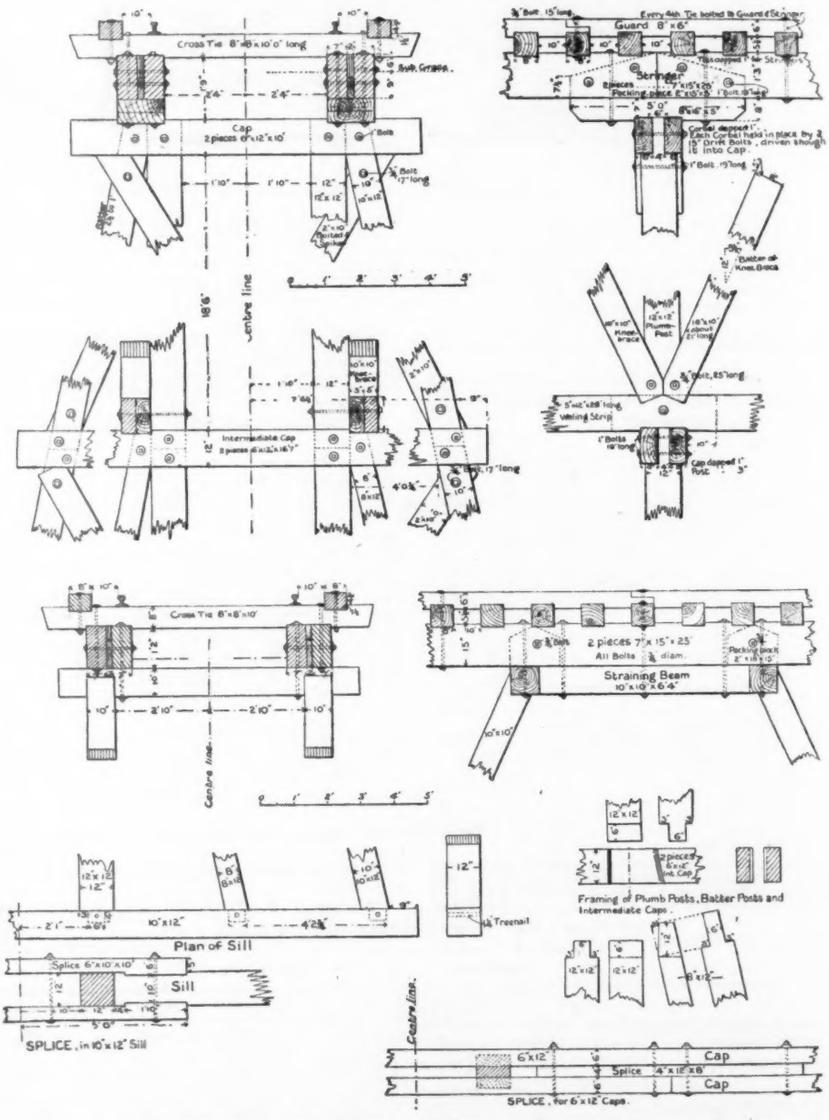


Fig. 6.—Standard Trestle Details, Norfolk & Western Railroad W. W. COE, Chief Engineer.

circumstances, and put on a sound constructive basis. There was not the slightest doubt that this could be done with mathematical certainty. He protested against the committee's recommendations to replacing the present stone vault by an iron or a wooden ceiling, as being unworthy of the grandness of the design, as involving an unnecessary and humiliating confession of weakness on the part of American constructive ability, and as tending to deplorably impede the development of monumental architecture in this country, in all of which claims we must confess that we sympathize.

Since this hearing has taken place Governor HILL has signed the bill, and the decision of just what is to be done now rests with the Speaker, and the committee to be appointed by him. It is to be hoped that they will not take council of their fears but of their reason, and not discredit the engineering and architectural talent of the State by such a radical change of design as proposed, until the necessity becomes clearly apparent on further investigation.

The latest news seems to be that the half million dollar stone ceiling is to come down and a wooden one be substituted, using the same massive stone columns which were quite suitable to support groind arches but make themselves ridiculous when supporting a light wooden ceiling. This last absurdity at least, we trust we shall be spared, and since there is no dispute that the original ceiling was architecturally fine and only constructively bad, we fail to see where the necessity comes in for such a total change of plan. Passing the possibility of restoring the stone arches on lines better conforming to the lines of strain, the arches may be made lighter by the use of brick, still lighter by the use of hollow brick, and may be made both lighter and ornamental by the use of terra cotta. The question of comparative acoustic properties is also an important one, but unless there is shown to be a decided difference in this respect it should hardly be a controlling one.

Cuban Railway Operating Expenses.

A Cuban subscriber sends us the subjoined table showing the average for two years of the operating expenses of the Cárdenas & Júcaro Ry., one of the principal lines of Cuba, analyzed in the same manner as that adopted in Mr. WELLINGTON'S "Economic Theory of the Location of Railways", with the average of American experience added for comparison. The record is interesting as showing how nearly the percentage of the various items of expense remains constant under however diverse conditions, as also in showing how absolutely fallacious the percentage of operating expense to income is as an index of economy.

Thus, the lower part of the table shows that this railway is operated at an average expense of about 33⅓ per cent. of the receipts, one of the very lowest in the world—probably the lowest for so considerable a system—the average rate in America being 60 to 65 per cent. It may be seen at a glance, however, what the reason is; not that the expenses are less, for on the contrary they are $1.62 per train mile, but that the receipts are enormously greater, being $4.36 per train mile against $1.49 in the United States. There is no more common error than to assume that this per cent. of operating expenses is an indication of operating economy, which is absolutely untrue. For example, it is so used in Mr. DORSEY'S paper on "English and American Railroads Compared" to prove that the English capital expenditures for obtaining straight lines and low grades were economically inexpedient. Mr. DORSEY'S conclusion is true; but his proof, as respects this matter, is entirely unsound.

That the percentage of the various items should hold as nearly constant as they do below, in spite of their aggregate amount being nearly double, is certainly curious. The only serious difference is in the cost of maintenance of way, and this only in one item, renewals of rails, which was 8.98 per cent. on the Cuban road, against an average of 2.0 per cent. in the United States, probably because the Cuban road happened to be renewing a good many rails in the two years included. Had this been down to a normal basis, the percentages of all the other items would have corresponded much more nearly than they do to the American average, so much so that the latter probably represents more correctly the normal average of the Cuban road than do its own figures, in spite of there being such a difference in the aggregate cost and in all the operating conditions.

Details of the Operating Expenses of the Cárdenas and Júcaro Ry., Cuba, 1885-1886.

					Cents per t. mile.	Per centages.	Av. U.S cts. per t. m. or %
Train exp.	cts. per t.m., 68.27; per cent., 42.26; av. U. S. %, 47.00	Engines.	cts. per t.m., 32.37; per cent., 20.03; av. U. S. %, 18.00	Fuel	11.18	6.92	7.6
				Oil and waste	2.47	1.52	.8
				Repairs all engines	18.72	11.59	8.6
		Train wages and supplies.	cts. per t m., 23.39; per cent., 14.48; av. U. S. %, 17.00	Engine wages	12.20	7.55	6.4
				Car wages	10.74	6.65	8.5
				Carsupplies	.45	.28	.5
		Cars.		Repairs and renewals	12.51	7.75	12.0
Maintenance of way.	cts. per t.m., 52.82; per cent., 32.69; av. U. S. % 23.00	Permanent way.	cts. per t.m., 46.02; per cent., 28.48; av. U. S. %, 17.50	Renewals of rails	14.52	8.98	2.0
				Repairs to road bed	25.38	15.71	12.5
				Renewing ties	6.12	3.79	3.0
		Structur's	cts. per t.m., 6.80; per cent., 4.21; av. U. S. %, 5.50	Repairs to bridges	4.78	2.96	3.5
				Repairs to buildings	2.02	1.25	2.0
Total "line" or transportation expenses					121.09	74.95	70
Station and general.	cts. per t.m., 40.47; per cent., 25.05; av. U. S. %, 30.00	Stations and Telegraph	cts. per t.m., 22.68; per cent., 14.04; av. U. S. %, 12.0	Station service. Incl. tele. op.	21.57	13.32	11.0
				Station supplies	.72	.44	
				Telegraph supplies	.45	.28	1.0
		General.	cts. per t.m., 17.79; per cent., 11.01; av. U. S. %, 18.00	General officers and clerks	13.50	8.36	4.0
				Office expenses	1.36	.84	3.0
				Sundry expenses	2.93	1.81	10.0
Total station and general expenses					40.47	25.05	30.0
Total operating expenses					161.56	100.00	100.00

NOTES.

Miles operated 1885-1886, 200. Train miles 1885-1886, 310,000.
Total tons hauled, 370,000. Total passengers, 270,078.
Total freight trains, 2,576. Total passenger trains, 3,650.
Average load per freight train, 140 tons (Av. U. S. 1885, 143 tons).
" " per passenger train, 74 passengers. (Av. U. S. 18-5, 43¾ passengers).
" freight trains daily, 3.5 each way (Av. U. S. 1885, 3.81 trains) } Total daily trains each way = 8.5
" passenger trains daily { main lines, 3; branch lines, 2 } each way (Av. U. S. 1885, 2.36)
Total, = 5
Ninety per cent. of freight hauled from December 1 to June 1.
From June 1 to December 1 freight trains carried an average load of 60 tons.

	Av. U. S. 1889.			Av. U. S. 1885.
Earnings per train mile	$4.358	$1.488	Gross earnings per mile operated	$6.812.45 $6,220
Expenses "	1.616	.903	Expenses "	2.525.53 4,050
Net earnings per train mile	2.742	.585	Net earnings per mile operated	4 286.92 2,170
Coefficient of exploitation	37.07	60.8	Coefficient of exploitation	30.07 65.1

Dividend declared by the C. & J. Ry. for 1885-1886 on a total share capital of about $7,100,000 U. S. Cy. = 12 %.
The company has no mortgage or interest bearing obligations.

The Cuban train loads are very creditable to the management, especially the freight train load of 143 tons, under the difficulty mentioned, that 90 per cent. of the freight is hauled in six months of the year, and that in the remaining six months the average train-load is only 60 tons; but the grangers are evidently not a very powerful body there, or it would not be possible to collect such high rates.

The Trans-Caspian Railway.

When the Trans-Caspian Railway was begun, nearly 9 years ago, the general expectation was that it would be a line of minor importance across the Kara-Koom Desert but as the work progressed it became evident that the scheme was one of greater magnitude and importance than was at first supposed. The line was extended toward the southeast, striking the Persian frontier near Kizil Arvat and running parallel to it thenceforth. Soon the news came that the line had reached Merv, and a little later rumors were current of a branch line running southward to Meshid with a bridge over the Oxus River at Tcharjui, with another line forking from it and stretching away toward the Afghan border and Herat. The history of this line shows with what facility the Russian Government and people dissemble, for while the world was laughing at the apparent slowness with which a small piece of work was being executed, a great enterprise was being pushed with a rapidity which considering the difficulties encountered, has rarely been surpassed.

When the British Government realized the full significance of Russia's strategem, the unfinished railway across the Beloochi Desert was pushed forward with feverish haste, and branch lines and military roads were rapidly constructed, being a most remarkable instance of how occasionally the needs of war may help to develop the internal communications of a country.

The line which has recently been completed is of same gauge as the great railway system in Russia itself, which is 5 ft. Its total length is 906 miles, the last 236 miles from Tcharjui to Samark having been built in an extremely short time. One of the most important structures on the line is the bridge over the Oxus, which had to be very high on account of the periodical rising of the river. Most of the construction has been done by subjected Telka Turcomans under Russian superintendence. Although the road is safe, its construction is much less expensive than that of the ordinary European road.

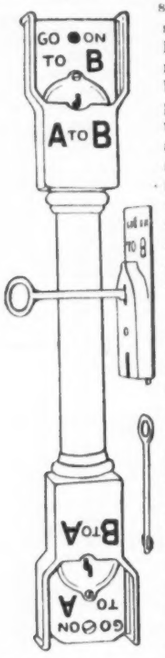
The present equipment of the line consists of about 100 locomotives and 1,100 carriages. As the gauges are the same, the Russian railways may be drawn on for rolling stock in case of emergency. The speed practicable on the line will average 22 miles an hour, though in some places only 10 miles an hour can be made. The locomotives use naphtha as fuel and have to carry sufficient water to get them across the desert.

Although the purposes of the road are mainly strategic and political, there is no doubt that many commercial advantages will arise from it in co-operation with the navigation already existing on the Oxus River. The ruby and lapis-lazuli mines of the Upper Oxus, and the mineral deposits along the Zer-Affshan river, are only awaiting development to furnish traffic for the new line. Anthracite and petroleum, which are said to exist there, will add to the value and business of the road, and in all probability the dikes and reservoirs which existed some 2,000 years ago, to the northeast of Askabad, will be renewed and an immense tract of land made fertile by irrigation.

THE Sediment Machine Co. has introduced in New Orleans a new device for cleaning cisterns. A 2 in. augur hole is bored almost through the cistern wall, close to the bottom, and a hollow plug provided with a stop valve is then secured in a reamer on the end of the plug clearing out the hole. A long brass tube with a movable joint is then inserted, and through this tube, which is carried to every part of the bottom, the dirt is drawn. In a short time the cistern is cleaned, and with the loss of very little water.

The Train Staff System.

Few Americans know much about this system of securing safety from collisions on single track lines, which is wholly unused in this land of many single tracks, although it is extensively used on the comparatively few single tracks of England, as a substitute for any other form of train dispatching or block signal protection. It consists in its simplest form, as originally introduced, of a single staff, the mere possession of which entitles the holder to exclusive running rights over a section of track between *A* and *B*. As it is a physical impossibility for more than one man to hold the staff at once, it appears as if it should be a physical impossibility for more than one train to be between *A* and *B*, and it for the most part proved so, although some disasters have occurred nevertheless from infraction of rules.



Wise's Train-Staff.

It was early found to be inconvenient, however, in requiring the trains to alternate in direction between *A* and *B*, and hence the addendum of tickets was introduced to enable two or more trains to follow each other in the same direction, while still preserving the essential peculiarities of the system. How this is done is sufficiently explained below in the extracts which we make from a circular describing the advantages of the improved type (WISE'S train staff) which we illustrate, manufactured by McKenzie & Holland, of Worcester, England, which we believe to be the best and most approved form in use.

Its main features are that the tickets (made of metal) and called "train permits", are contained *in* the staff, in fact, form a portion of the staff itself.

A staff made to contain three permits will admit of four successive trains running in one direction, and the number of permits would vary according to the requirements of the traffic. The staff may be constructed to contain as many permits as necessary. As shown in the cut it has three recesses or pockets at each end, numbered 1, 2, 3 respectively. Into these are locked the permits correspondingly numbered, which can only be released by means of a key, the permits at one end of the staff being for up-trains, at the reverse end for down.

The mode of working is thus:—

The staff is used on a section of line between two crossing stations, say *A* and *B*.

The permits at one end are from *A* to *B*, and engraved, "*Go on to B*"; the reverse end are from *B* to *A*, and engraved, "*Go on to A*."

The station master at *A* wishing to send a train on to *B*, and having one or more trains to follow, takes his key, which will only release the permits at the *A* end, and gives one permit to the driver. This should be done on the platform and in the presence of the latter, who is thus assured that the staff is behind him.

This permit will take the driver to *B*, where he hands it to the station master, who keeps it with successive ones till the staff arrives; he must then replace the permits already received from *A* in their respective pockets in the staff, where they lock themselves automatically.

He can then unlock the permits at the *B* end, and return train with them to *A*, sending the staff with the last train, as before described.

The advantages of this staff are as follows:—

1. By no possible means can a permit be obtained without the staff being present.

2. No delay whatever is caused at crossing stations, as all the station master has to do is to unlock the permit and hand it to the driver, which operation can be done on the platform; in full view of the latter.

3. The driver can always tell when running with either staff or permit if there is a train in front of him or not, by the number on the permit or by the empty pockets in the staff.

4. As no supply of printed tickets is required, a considerable annual expenditure is saved.

The Board of Trade has agreed that the staff and ticket system is by far the safest. The old staff and printed card tickets as used upon most railways has many drawbacks, amongst which may be mentioned:—

1. The danger of more than one ticket being removed from the ticket box at a time, and the possibility, in the absence of the staff, of the second ticket being used by a careless driver, which might cause a serious accident.

2. Great delay caused at crossing stations while the station master is going into the booking office, unlocking the ticket box, and writing out driver's name, date, etc., on each ticket as required.

3. The driver is unaware when running on either staff or ticket as to whether there are one or more trains in front of him.

4. The driver has no control over the ticket boxes, and depends for his safety upon the regulations being strictly carried out by others.

5. The wear and tear upon the staff and ticket boxes, if not properly constructed and kept in good repair, often allow of the staff being removed from the box without the box being shut, thus enabling anyone to take out a train ticket without the presence of the staff.

6. The cost and constant trouble of keeping up a supply of printed tickets for each station.

These deficiencies are effectually obviated in WISE'S patent staff.

While this system answers admirably for short branch lines which make up the bulk of the English single track system, it would probably be anything but satisfactory under the more complicated operating conditions of our long single track lines, for which our system of telegraphic train orders is much better adapted, and probably safer as well; but that there are many short and light-traffic roads in this country on which this train-staff system could be used to advantage, we fully believe.

A New Irrigating Project in Idaho.

Mr. FRANK RIBLETT contributes to the Cassia County (Idaho) *Times* an interesting communication on the subject of a proposed grand canal for irrigating Snake River valley, the preliminary survey of which he has made. He estimates that a canal 125 miles in length will supply water to 300,000 acres; that a canal 200 miles in length will furnish water to irrigate 600,000 acres, and by going a little higher for a start and making an extension across Salmon Falls valley he believes 1,200,000 acres can be furnished with water. He believes that the cost of the canal would not exceed $2.50 per acre for every good acre covered by it. He estimates that Snake river has sufficient water to irrigate 10,000,000 acres. Further, he calls attention to magnificent stretches of rich lands that are now lying waste for want of water, and shows by their location, fall, etc., that the scheme is entirely practicable. The further main points of the project are thus described:

The Snake River valley consists of two plains, sloping towards each other along the line of Snake river, and at the same time sloping toward the west. The fall of the valley is about 600 ft. in 100 miles. The canal would require a fall of about 6 ins. to the mile.

Making 25° Fahr. the lowest limit, such work would not be delayed more than 2 months during our average winters. During the past winter, the most severe known for 50 years, the delay would not have been over 10 weeks. The ground has been fit for ploughing and scraping ever since Jan. 28 last.

Snake river is at all seasons of the year a large stream; will furnish water for the irrigation of at least 10,000,000 acres of land, would always furnish sufficient depth of water at the head to float the dredging machines; many tributaries could be used for dredging purposes before and after the irrigation season; some would furnish water sufficient for this purpose during the entire year. The evaporation of water from the irrigated lands would have a tendency to increase the permanent regular supply of water in Snake river and its tributaries. On the eastern side of the Pacific slope is the great Rocky Mountain range. The flanks of this chain will receive the evaporation clouds, driven against them by the westerly gales, and condense the vapor into rain or snow, increasing the supplies in those natural storage reservoirs.

The volcanic soil is easy to handle. The percentage of loose rock is very small and that in loose washes. The cost of labor and teams would probably be about the same as in the States. In regard to fuel, Snake river is lined with thousands of cords of drift wood and the canal will run near many large groves of cedar; wood can probably be furnished to run the engines at but little above the cost of chopping. Any proposed head will be near a railroad depot. Convenient saw-mills can furnish any quantity of lumber or timbers required, including red pine sticks, 50 to 60 ft. long, 10 × 10 or any other required size. This red pine is proven by actual test to be superior to oak for such purposes in the West.

In other States and Territories a permanent right in such canals is sold at $10 per acre and upwards. The purchaser of a permanent water right in one of these canals becomes liable for his proportionate yearly share of the expense of maintenance and supervision. Season rent is from 75 cts. per acre upwards.

This immense body of fine land with a large stream perennially flowing through it cannot long remain a desert. By private or public enterprise it must soon be redeemed. The traveler can find much here to interest him in the way of scenery and wonders. Here are falls grander than Niagara, cliffs and canyons only surpassed by the Grand Canyon of the Colorado; immense caves and craters, mountain lakes, large game and fish, mines surpassing those described by HAGGARD in "King Solomon's Mines", [We print this statement with reservations. ED.] only waiting water from the great canal to be opened in all their grandeur, and many other attractions too numerous to describe.

CORRESPONDENCE.

Wrought-Iron Cylinders and Concrete

ATLANTA, Ga., June 16, 1888.

EDITOR ENGINEERING NEWS:

Can you give me any information showing the action of fresh running water on wrought-iron plates? For instance, how long will cylinders of wrought-iron plate ⅝ in. in thickness last, when exposed to the action of running water? Can you give me any instances where the cylinder plates have been entirely destroyed, and the concrete body of the pier continued to do service as a foundation? What do you consider the best proportions for concrete to be used in filling wrought-iron cylinders, and what would be your specification regarding the dimension of stone used. Yours truly,

F. W. W.

[If our correspondent has been wise enough to preserve and bind past volumes of ENGINEERING NEWS, or even the current one, he can find no end of information on all these points scattered through them, but perhaps some of our readers can add from their own experience to this information.—ED. ENG. NEWS.]

Soft Sandstone Excavation Under Water.

Chignecto Ship Railway.

AMHERST, N. S., June 16, 1888.

EDITOR ENGINEERING NEWS:

We propose to remove about 30,000 cu. yds. of a soft, coarse, red sandstone from the bottom of a harbor, in from 16 to 25 ft. of water.

Is there any dredge or other machinery that will remove it advantageously without explosives?

How has the chisel machine worked, described in ENGINEERING NEWS some time ago as being manufactured for the Suez Canal works; and how would it work in sandstone? Yours truly,

J. S. ARMSTRONG.

[We doubt very much if such rock as described can be handled successfully without blasting; at least, blasting is a sure process, and any other will have more or less the nature of an experiment, and be possibly a costly and unsatisfactory one; and the amount to be removed is not enough to pay for a great deal of such experimenting. The cheapest way would probably be to explode dynamite on the surface of the rock without drilling, and take out the pieces with grapple or scoop.

So much depends on the meaning of the word "soft" that it is hard to recommend anything without knowing first what the rock is and how it lies. If it is in layers, it would be possible to dig it with a powerful scoop machine with a small, heavy dipper, with teeth which could get under it and break it up, as the phosphate rock is dug in South Carolina and as they dug shale rock at Montreal, but the rock must be quite soft and friable to make this pay.

All we know about the chisel machines is what has been published in ENGINEERING NEWS, and that covers only tests made on dry land and in shallow water, and covers only reports from friendly sources. We have seen few reports of their work in actual service; but if they will do good work anywhere, they ought to do it in soft sandstone. Even with such a machine the rock will have to be dredged after breaking it up, and we should think that for 30,000 cu. yds. it would be cheaper to use dynamite than build the machine, unless there were further use for it. It ought not to be a very expensive machine, however; and in the interests of engineering rather than of our correspondent's pocket, we hope he will build and use it. ED. ENG. NEWS.]

A Hydraulic Conundrum.

SCRANTON, Pa., June 18, 1888.

EDITOR ENGINEERING NEWS:

I think the "Hydraulic Conundrum" propounded by A. B. C. in the June 16 issue of your paper should be solved in reference to the varying pressures at point of junction, instead of at *F*. We must assume the water flowing freely at *F*, which although not probably the case, is necessary in order to create the requisite data. The elevation of junction should have been given, to make the problem more complete, and the distances given were indispensable.

In what follows, the resistance of entry, and loss of head necessary to annul velocity of exit, are omitted as being small in comparison with frictional resistance.

When *C* is closed and *A* and *B* open, a simple proportion gives elevation of hydraulic grade line at junction equal 158.33 ft. This elevation, minus that of junction, gives head of water at that point.

When *A* is closed and *B* and *C* open, the elevation at junction is similarly found to be 141.86 ft. Pressure at junction obtained as above.

When *B* is closed and *A* and *C* open, elevation at junction is found in the same manner to be 139.13 ft. Pressure obtained as before.

When *A*, *B* and *C* are all open, the problem becomes more difficult, but is simplified in the present case by the fact that the diameters, and therefore the areas also, of the pipes, are equal.

We must find a head at the junction such that the discharge from the pipes leading from the two reservoirs will be equal to that from the main with which they connect.

Calling, for the moment, the elevation at *F* equal to zero, we have in the present case, in order to determine the desired elevation *H*, at the junction, the following equation.

$$\sqrt{\frac{H}{1800}} = \sqrt{\frac{100 - H}{2500}} + \sqrt{\frac{50 - H}{500}}$$

which reduces to:

$$\sqrt{\frac{H}{18}} = \sqrt{\frac{100 - H}{25}} + \sqrt{\frac{50 - H}{5}}$$

This equation can be solved by approximation, and gives, about,

$$H = 49.5$$

adding the elevation of *F*, we have for the elevation of hydraulic grade line at junction when all the stop-cocks are open, 149.5 ft. Subtracting the elevation of junction, would give, as before, the pressure in feet of water at junction.

There would be, therefore, in this case and in round numbers, about 10½ ft. more pressure at junction when all the stop-cocks were open, than when *A* and *C* were open, and *B* shut.

The above has been worked out rather hurriedly, but I think your correspondent will find it correct.

G.

Proposed New Brunswick Dam.

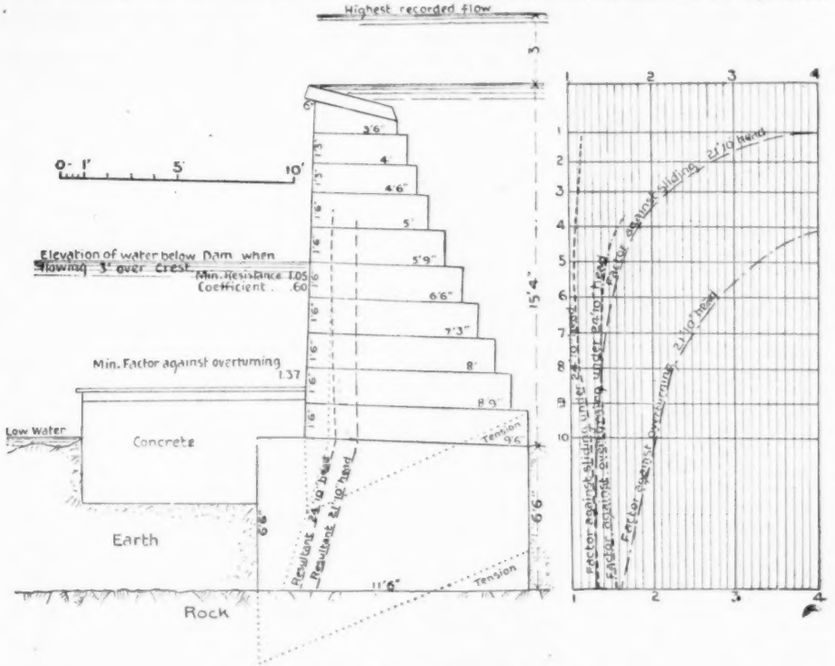
NEW BRUNSWICK, N. J., June 7, 1888.

EDITOR ENGINEERING NEWS:

I send herewith a sketch of the proposed dam for the New Brunswick water-works, together with the results of some calculations I have made to determine its stability, which I hope may prove of interest to you. The tabulated data are reproduced in a more readily comprehensible form in the diagram opposite the section of the dam.

Yours truly,

A. B. C.



Proposed Dam at New Brunswick, N. J.

Proposed New Brunswick Dam. Synopsis of data, 21 ft. 10 ins. head = level with top of dam.

Joint.	Distance from down stream end to a line through center of gravity.	Weight of masonry, lbs.	Weight of water resting on masonry above joint, lbs.	Total weight above joint, lbs.	Horizontal thrust of water above joint.	Reverse thrust of water above joint.	Net horizontal thrust of water above joint.	Center of pressure above down stream end of joint.	Factor of safety against sliding.	Factor of safety against overturning.
1	.....	735	119	854	.....	.....	132	.....	3·88	....
2	.....	1435	181	1619	.....	.....	351	.....	2·77	....
3	.....	2272	289	2511	.....	.....	672	.....	2·24	....
4	2.50	3272	434	3706	.....	.....	1190	1.89	1.87	4.12
5	2.75	4479	727	5206	.....	.....	1850	2.36	1.69	3.28
6	3.10	5844	1083	6927	.....	.....	2655	2.88	1.56	2.81
7	3.50	7366	1508	8874	.....	.....	3640	3.33	1.46	2.56
8	3.75	9046	2090	11046	.....	.....	4720	3.88	1.40	2.27
9	4.10	10882	2580	13462	.....	.....	5950	4.35	1.36	2.13
10	4.50	12878	3253	16131	.....	.....	7340	4.83	1.31	2.04
B	6.16	23343	3253	26596	14850	1300	13550	6.93	1.30	1.63
			24 ft. 10 ins. head.							
1	.....	735	869	1604	.....	....	812	.....	1.18	....
2	.....	1435	1028	2463	.....	...	1766	.....	1.16	....
3	.....	2222	1227	3449	.....	....	1828	.....	1.13	....
4	2.60	3272	1466	4737	.....	...	2655	2.39	1.07	1.61
5	2.80	4479	1899	6378	.....	...	3640	3.36	1.05	1.46
6	3.15	5844	2935	8239	4720	70	4650	3.88	1.06	1.42
7	3.55	7366	2960	103·6	5970	281	5679	4.33	1.09	1.40
8	3.80	9046	3593	12639	7340	618	6722	4.88	1.12	1.37
9	4.15	10882	4314	15196	8812	1125	7687	5.35	1.20	1.40
10	4.55	12878	5128	18006	10468	1734	8734	5.83	1.24	1.44
B	6.24	23343	5128	28471	19187	6125	13062	7.93	1.31	1.56

[This proposed dam seems to be exciting a good deal of interest in New Brunswick, judging from the fact that we published last week another illustrated criticism showing substantially similar results; and very naturally, for it is clear that it sails needlessly close to the wind. We have not gone through the details of the calculation, but there is one fact which may be appropriately noted in this connection; that a much larger allowance for contingencies is required in small works of this kind than in larger ones, whose mass is so great as to almost eliminate danger from minor local imperfections. The Quaker Bridge dam may be conformed closely to theory, but not small dams, safely.—ED. ENG. NEWS.]

Gautier's Telemetrical Telescope.

CARDENAS, Cuba, June 6, 1888.

EDITOR ENGINEERING NEWS:

Can you inform me of any instrument maker who manufactures "Gautier's" Telemetrical Telescope, as described by HAUPT on page 387 "Topographer". Please give me his address.

Y. POLLEDO.

Crushing Strength per Square Inch.

CHAMPAIGN, Ill., June 5, 1888.

EDITOR ENGINEERING NEWS:

In connection with the discussion, in ENGINEERING NEWS of May 26 and succeeding issues, on the above topic, will you allow me to quote a few sentences from Gen. GILLMORE'S posthumous "Notes on the Compressive Resistance of Freestone, etc.", received since arriving at the conclusion expressed in my former communication (ENGINEERING NEWS, June 2, page 458).

"Our experiments made in 1875 seemed to indicate that with cubes of the same material the crushing resistance per square inch of compressed surface increases, approximately, in the ratio of the cube roots of the sides of the respective cubes. The range of the experiments was too limited to justify the assumption that the formula deduced from them would prove sufficiently correct when applied to larger cubes. It was noted at the time that the formula was not borne out by the results obtained with five 11-in. cubes of Berea stone that were crushed at the Brooklyn Navy Yard. They gave way at somewhat less recorded pressure per square inch of bed-surface than 2-in. cubes of the same stone. The question whether there is a gradual increase or decrease of compressive strength per square inch of pressed surface, as the sizes of cubes of the same kind and quality of stone or similar building material increases, was therefore still unsettled. (p. 6).

"It was decided to extend the former experiments with this (the Watertown) new and more powerful machine. It was thought best to select materials possessing as uniform texture as practicable, in order to exclude, if possible, disturbing influences resulting from the different nature, size and unequal distribution of individual grains. In addition to uniformity of texture or grain, the degree of hardness and toughness was considered. (p. 7).

* * "Former examinations and tests of the softer varieties of building material suggested a variety of red sandstone known as Haverstraw freestone. Cubes of this material, varying, by increments of an inch, from 1 in. to 12 ins. on a side, were prepared, 4 cubes of each size being made. Each sample of sandstone was wrought to its proper form by a skilled stone-cutter and the bed-faces were rubbed plain. (p. 8).

"Cubes of neat (Portland) cement were prepared, in order that a material presumably of as nearly homogeneous texture as practicable might be tested. The sides of the cubes made of this cement varied by increments of an inch from 1 in. to 12 ins. There were 6 samples of each size. (p. 8) * * "A number of mortar and concrete cubes of various sizes were made, using different brands of American cements. (p. 9).

"*The law of increase of compressive strength per square inch of bed-surface*, with increasing size of cubes, which was based upon experiments made some ten years ago with various but limited sizes of Berea sandstone, *was not confirmed when larger cubes of Haverstraw sandstone, cement, mortars, and concretes were tested.* (p. 111, italics by the writer of this.)

"The recent tests at the Watertown Arsenal also failed to show the continuance of this law beyond small cubes. (p. 22).

"The average strength of 1-in. cubes of Haverstraw freestone tested at the Watertown Arsenal was 7,090 lbs. per sq. in. This was exceeded by the 5-in. and 6-in. cubes, which yielded under average pressures of 7,440 and 7,354 lbs., respectively. According to the law deduced from the Staten Island experiments, we have

$$y = a\sqrt[3]{x} = Ax^{0.333};$$

but actually we have for 5-in. freestone cubes, $y = Ax^{0.333}$ for 6-in. cubes, $y = Ax^{0.338}$; a being = 7,090 lbs. (p. 24). * * "The question still remains un-

settled whether stone, approximately homogeneous, when in the form of larger blocks or cubes exhibits greater (*sic*) compressive strength per square inch of bed-surface than smaller cubes." (p. 111.)

Accompaning this is a diagram on which are plotted the experiments on Haverstraw sand stone cubes, made with the Watertown testing machine under direction of Gen. GILLMORE, to test the above law. The points present the individual experiments, and the cross represents the mean strength of the several cubes. The dotted lines horizontally through the table, show the average strength per square inch of all the cubes. The formula under discussion requires that a shall represent the strength of 1-in. cubes; but as the 1 in. cubes are among the strongest, the curve was plotted for $a = 6000$, which is even less than the mean of all the cubes. The curve as plotted does full justice to the law (?).

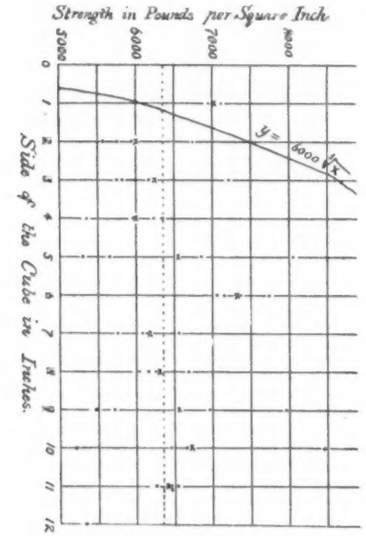


Diagram Showing Compressive Strength of Haverstraw Sandstone.

An inspection of the diagram shows at a glance that the curve does not, even approximately, represent the strength of these cubes. Bear in mind that the above experiments were made under the direction of Gen. GILLMORE, to test this very law, with cubes of the same kind of stone (selected because of its great uniformity), carefully cut, and all tested at the same time by skillful operators with what "is recognized as the most perfect and reliable machine in existence"; therefore, if they fail to confirm the supposed law, it is good evidence that no such law exists. The only experiments ever made which conform to the law, were the two series by Gen. GILLMORE previously referred to, in which only one cube larger than 3 ins. was tested. All of the more extended series "were not taken from the same block of stone". One series was tested between wood cushions of varying thickness, and one between steel. It was assumed that the friction of the testing machine varied as the power exerted; and herein is probably the explanation of the discrepancy. It would at least seem that the Watertown experiments are the more reliable.

These experiments, as well as the others referred to in my former communication (June 2), show that the strength per square inch is nearly constant for all sizes of cubes; and in view of the small number of experiments and their great variation, we cannot do more than say that, as far as the evidence of experiments shows, the strength is independent of the size of cube, and it certainly does not vary as the cube root of the side of the cube. The experiments in the above diagram are very well represented by the dotted line, the average strength of all the cubes.

IRA O. BAKER.

[Our correspondent has very much strengthened his case. These experiments certainly seem to indicate that in cubes of various sizes as much is lost by the extra height of the block as is gained by the extra cross-section, so that the strength per square inch remains approximately constant. But the case can hardly be considered proved, it seems to us, by any one series of experiments, unless the effect of applying the pressure in different manners was carefully tested. The larger the area the more difficulty there is in securing uniformity of pressure over the whole area, and the more danger there is that the corners will fail under very light pressure, and so induce failure in detail. We have not at hand the details of these tests, but it is obvious that as the size of the cube increases the central areas are very much strengthened while the exterior areas are very much weakened, so that even, uniform initial pressures hardly give the large block a fair chance to develop its ultimate strength. There are evident arguments in favor of securing uniformity, nevertheless, but it would be interesting to know if a different manner of distributing the stress, somewhat relieving the corners and edges, would not develop a higher aggregate resistance.—ED. ENG. NEWS.]

The Proper Cross Section for Reservoir Walls.

CHARLESTON, S. C., June 11, 1888.

EDITOR ENGINEERING NEWS:

I have recently had occasion to consider the subject of Reservoir Walls, and have re-read with much interest the reports of Mr. B. S. CHURCH, Chief Engineer of the new Croton aqueduct, and of Mr. A. FTELEY, consulting engineer, together with your editorial comments thereon, in previous numbers of your journal, early in the current year. As engineers are by no means agreed as to the proper form of cross-section, I venture to suggest, for a dam of the height of the Quaker Bridge dam (258 ft. from the surface of water down to the foundation) the one accompanying this paper, which was designed, as was the Quaker Bridge dam, for masonry of 2½ times the specific gravity of water, but is supposed to be acted on by water on one side only. Although comparison is drawn with the Croton dam alone, it is only because Mr. CHURCH has afforded numerical values which make it easy to compare the two types: but the criticisms will equally apply to other well known types, and must be understood to be general. [For convenience of comparison we have added the proposed profile of the Quaker Bridge dam in dotted lines.—ED.]

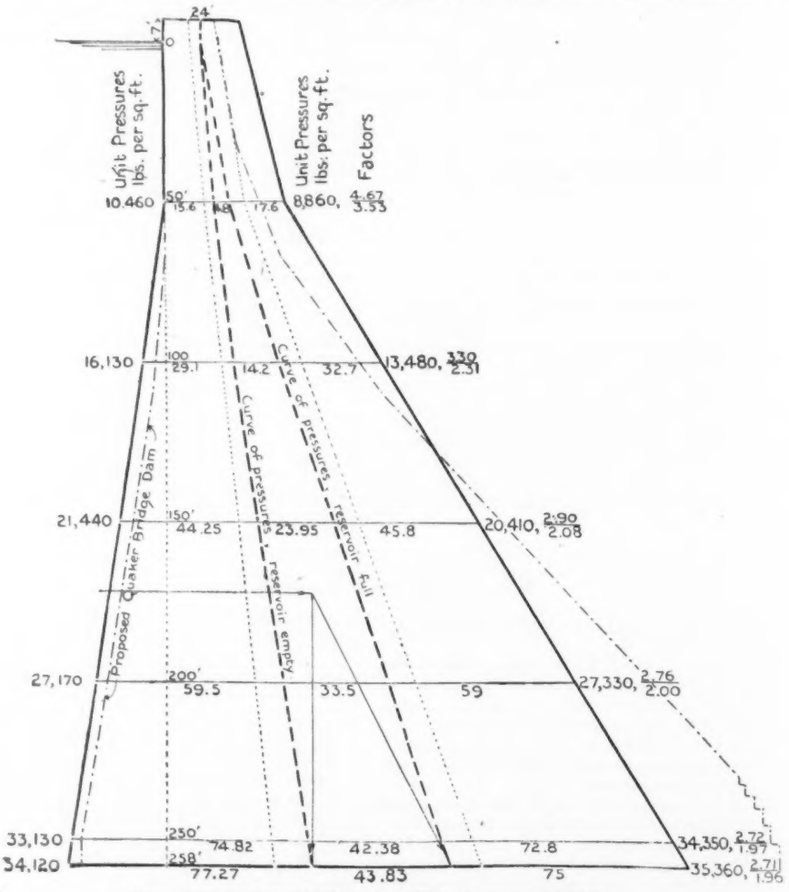
Mr. FTELEY has well summed up the three well known conditions that are to be observed in designing the profile of a dam as follows:

1. The point of application of the resultant of the forces acting on the dam, whether or not it be under water pressure, must not be beyond the center third of the base.

2. The pressures on the masonry at either face, and at any point, must not exceed a certain safe limit.

3. The sections of the dam, at any point, must be such that no sliding can take place.

These conditions are all observed in the section proposed, (see figure) and in addition, the factors of



The Proper Cross-Section for High Reservoir Walls.

safety against overturning, although nearly uniform for the lower half of the dam, *increase* gradually as we proceed upwards to allow for the proportionately greater increase of stress due to wind and wave action, ice, floating bodies or other accidental causes.

It is here that I contend the section shown to be stronger than the proposed Croton dam, in which the factors against overturning actually decrease from near the base to 66 ft. below the surface of water, above which they increase again.

In the accompanying figure, the up stream or inner face of the dam is seen to be vertical for the first 57 ft. (the water surface being 7 ft. from the top), then to batter at the rate of 30 ft. in 200 to the base. The dam is 24 ft. wide at top, 38 ft., 50 ft. below the water surface, and 196.1 ft. at the base, 258 ft. from the surface of water, the outer face sloping uniformly from the top to 50 ft. below the water surface, and again sloping uniformly to the base. The point of meeting of these two slopes can be rounded off with a curve, which however was not considered in the computations.

The unit pressures, marked at corresponding points on the inner and outer slopes in pounds per square foot, give the greatest intensity of stress at each end of the joint for reservoir empty and full, respectively.

These pressures, p, were found from the known formula,

$$p = \left(4 - \frac{6u}{l}\right)\frac{W}{l},$$

where l = length of joint,

u = distance from the point of application of the resultant to end of joint considered,

W = total weight of masonry above joint.

This formula is believed to be on the side of safety, and to give pressures, for the lower part of the dam, above those actually experienced. The numbers marked to the right of the figure, in the form of the fraction, give, for the upper figures, the factor of safety against overturning, or the factor by which it is necessary to multiply the horizontal thrust of the water to cause the resultant, to pass through the outer edge of the joint and for the lower figures, the ratio of the weight of masonry above a joint to the thrust of water, which is, in a certain sense, a factor of safety against sliding on a horizontal joint.

The curves connecting the centers of pressure on the various horizontal joints, or the "curves of pressure," for reservoir full or empty, are shown by the heavy broken lines of the figure, and these curves are seen to lie well within the center third limits as shown by the lighter dotted lines. The distances in feet, from the curves of pressure to the end of the joints, as well as the distance between these curves, are given on the figure.

The areas of the sections, the weights of the corresponding prisms of masonry and the water pressures, taking the weight of a cubic foot of water (62.5 lbs.) as the unit, are given in the following table.

Depth of joint bel'w surface of water.	Width of joint.	Areas above joint.	Weights or areas × 2.5	Thrust of water above joint.
feet.	feet.	sq. ft.		
50	28	1.767	4.417	1.250
100	76	4.617	11.540	5 000
150	114	9.367	23 420	11,250
200	152	16,016	40,040	20,000
250	190	24,567	61 420	31.250
258	196.1	26,111	65,270	33,282

The quantities in the last two columns will have to be multiplied by 62.5 to find the weights of masonry and water pressures in pounds.

The centers of gravity of the successive trapezoids were found graphically, the resultant center of pressure on any joint was then found by the usual method of moments, and the resultants on the joints and centers of pressure were found graphically. The position of the latter then, may differ a few tenths of a foot (as the scale used was only 20 ft. per inch) which is of no moment. The result was checked by calculation at some of the lower joints.

On comparing quantities with those pertaining to Quaker Bridge dam, we see that the total areas of cross sections are 26,111 and 26,219 sq.ft. respectively, or practically the same. The maximum stress at the outer toe of the base with reservoir full, for the Quaker Bridge dam, is 33,266 lbs. per sq. ft, and for reservoir empty, at the inner toe 30,828, which are both less than the corresponding numbers 35,360 and 34,120 for the section under consideration.

The weight of gravel lying over the lower part of the wall is included by Mr. CHURCH in the above, so that his figures are relatively still smaller; still, the difference in any case is not, in my opinion, sufficient to justify the decreasing factors of safety against overturning employed for the middle and upper portions of the work.

The design proposed is nothing more than the well known theoretical type, triangular in cross-section, with some additions at the top to allow for a roadway, wind and wave, etc. For a single triangular wall, vertical at the back, the centers of pressure for reservoir empty, fall at the limit of the middle third, and if for reservoir full the design is such that the resultants pass through the limit on the other side of the center, then for a double thrust they would all pass through the outer edges. Such a triangular wall should then be designed for a larger factor than 2, so that a slight increase in water pressure would not cause tension at the inner face. I have used about 2.7 to 3 for the lower half of the dam, but it must be borne in mind that this is not a true factor of safety, even supposing no cohesion at the joints; for a computation shows that if the water pressure on the joints 50, 100 and 150 ft. below the surface, should become 2, 1½, 1⅓ times the original, respectively, that tension would just begin to be exerted at the inner face. This would happen for the lower joints for a thrust about 1¼ to 1⅓ times the original. This effect is much more marked when the upper joints are narrower, as in usual designs. If from any cause, as an earthquake, the thrust should be considerably increased over these amounts, the inner joints would finally snap and open, and the structure would be materially injured long before the full factor of safety given above is realized. This result is, of course, much more marked for newly constructed work, with the joints not hardened, than for older walls, where cohesion adds materially to the so-called factor of safety.

It may possibly be objected to the above design, with some reason, that the greatest intensity of stress (34,120 lbs.) for reservoir empty, should be materially less than maximum (35,360) for reservoir full, as the first stress is experienced during or at the close of construction, whereas the other will not be exprienced until the reservoir is full and the cement has well hardened. The remedy is simply to increase the batter of the inner face, which will diminish all the stresses to any desirable amount, and this increase can be made simply on the lower portion if preferred.

The design of a dam, to have the same unit stresses at every outer joint leads, invariably, to tensile stresses, large in amount, at the inner face; and such a method should be rejected as faulty, especially as it diminishes the factors of safety as we ascend, whereas the reverse ought to obtain to allow for the accidental pressures near the top. If, therefore, the stresses at the toes are to increase as we go down, the maximum stress cannot control the profile. It can be diminished theoretically by sufficiently spreading the base, thus giving more acute angles at the outer and inner toes, but it is doubtful whether by this device the actual stresses at various points are altered materially when the angles are very acute, and on this account, as well as to save in foundation, the inner and outer slopes were made uniform to the base. The further spreading at the base, though, would have this good effect, perhaps, that even if the pressures at the old toes was *not* materially altered, yet now, being entirely surrounded with masonry, its resistance to crushing is enormously increased, for it is well known that a lateral support or pressure, even comparatively slight, adds considerably to the compressive strength of a block. It is on this account that I consider the pressure of the 87 ft. of gravel on the outer face of the Quaker Bridge dam as a positive help in enabling the material to stand a greater compressive stress.

It may be objected that the so-called factors against overturning and sliding at the various joints, should be more nearly equal. These factors are greater than the true factors when there is no cohesion of the mortar for horizontal joints, but the factor against sliding will be practically higher than that against overturning if the work is made to break joints vertically as well as horizontally, as should always be done. In fact, it may be shown that the tendency to slide is often greatest along an inclined plane passing near the outer toe and making an angle with the horizontal equal to the angle of friction of masonry upon masonry. See *Annales des Pont s et Chaussées* for May, 1887, on this point, which is verified in the manner of failure of the Habra dam (116 ft. high). This dam, of good design otherwise, was subjected to tension under still water on the inner face, which accounted in part for its breaking and sliding forward along an inclined base. It is suggested by M. CLAVENAD, to counteract this tendency in any dam, to use inclined or curved joints near the outer face. This is undoubtedly good advice, and such curved courses can approximately be perpendicular in direction to the resultants on the joints for reservoir fall, the normal condition of affairs.

We have, in the last place, to recommend that a gravity dam, as designed above, be made curvilinear in plan, convex up stream. As you suggest, Mr. EDITOR, the dam upon which the fate of a city may depend should be made as strong as possible to resist the enormous force of earthquake shocks or dynamite, as far as may be, especially when it costs but little, if any more.

This convexity is advisable for another reason, that a straight dam moves over at top under stress much more about its highest part than at its ends, where, if it is rigidly connected with the banks, longitudinal tension will be caused along its upper portions which is to be carefully avoided; even a slight convexity would tend to close up the joints along the top in place of tearing them open, and this very movement will set up a slight arch action even in a well designed gravity dam, which is the only kind considered in this article.

The form proposed is only intended as a preliminary study to point out what seems to be the best principles of design, and in that sense, is given to the profession. For the sake of architectural effect the upper portion may be curved and surmounted with recessed arches, etc., but these minor details can be easily worked in after the main principles of design are agreed upon.

In conclusion, I will state that I do not remember having seen the first design for the Quaker Bridge dam, but from your statement that it employed factors of safety of 2¼ to 2¾, I fancy it cannot differ greatly from the one proposed. Yours truly,

WM. CAIN.

The Kear & Lawrence Sewer Pipe Cleaner.

PITTSBURG, Pa., June 6, 1888.

EDITOR ENGINEERING NEWS:

I notice a paragraph referring to the Kear & Lawrence sewer pipe cleaner on page 326 of your journal. Let me say that their instruments do the work most effectively. In operating in this vicinity, I adopted this plan of getting the first cord through, viz., by means of a ball of fine fish line, making fast and allowing it to unwind as it passed through the column. I found this would not do in all cases, for if it did pass a gate, it would invariably come through unwound in part, having been cut by the gate. At other times it would deviate with the water column and go into fire plug connections and intersections. In working in Allegheny City, I was forced to abandon this and to devise a new form of instrument to carry the cord through. I passed this through 1,155 ft. of 6 in. pipe, only one-third of the opening being left, in 3¼ minutes. I passed it through a 5 in. column a distance of 500 ft. in 8½ minutes. This column was nearly closed. It has never failed to go when sent. Nothing but lead or an L bend will stop it.

I make mention of these fact with the assurance on my part that K. & L. scraper is the most effective I know of, and with the method devised by me for entering the first cord the process is as perfect as need be desired. I may add that the contract for cleaning in Allegheny City by this method has been awarded me this year by the Water Committee, and now awaits action of Council. Yours truly,

CHAS. H. MILLER.

The Bear Valley Dam.

REDLANDS, Cal., May 11, 1888.

EDITOR ENGINEERING NEWS:

I send you herewith some photographs, maps, etc., which will give you some idea of the Bear Valley dam; which I have been intending to send for some time, but have been unable to do so.

At the time a friend (Hon. H. M. BARTON) and myself discovered the natural fitness of Bear Valley for a reservoir, in May, 1883, there were comparatively few people in this section. The problem was to build a dam that would stay, and retain the water, with the amount of money at our disposal. Everything excepting the rock had to be hauled 100 miles by teams, over two mountain passes and across a desert. I saw that the only way we could accomplish our desire, was by building an arched dam, of the fine granite blocks at hand. About 2½ miles up the valley, we built a low earth dam (6 ft. high) the same summer (1883). Above this dam we caught and retained about 5 ft. of water over 450 acres or so Then began work in earnest in July, 1884.

From July till December I remained in Bear Valley working about 100 men. We cleaned off the

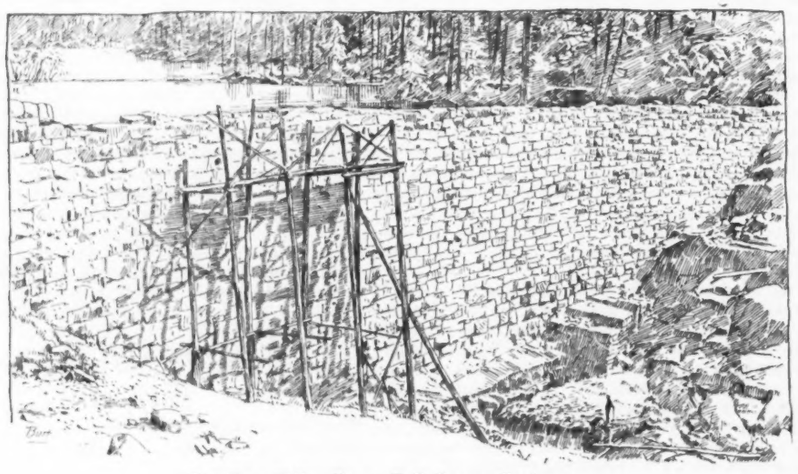
bed rock, (on the North end there was some 15 to 20 ft. or more of rock, mud, grass, etc.,) and built the dam as you see by the photographs. I could not have done this, if it had notbeen for the water stored above the temporary earth dam, 2½ miles up the Valley. As we built the dam, we placed the derricks on rafts of big logs; and floated these up gradually by drawing water from the Lake above, as needed. As you see by the contour map and table sent you, the stored water enabled us to build the dam up to quite a height, working nearly on a level. We opened our quarry on the edge of the water about 500 to 600 ft. away from dam, and supplied the derricks with rock, by means of big scows worked like ferry boats. As the water raised we moved our quarry back hi her, etc.

TABLE OF AREAS AND CAPACITIES, BEAR VALLEY RESERVOIR.
[Showing the effect of the proposed extension to 80 ft. height.]

Ht. of cont'r in ft.	Length Miles.	Area Acres.	Average depth ft.	Capacity, millions of galls.	Flow, Miners ins. f'r 100 days
10	0.36	4.95	2.93	4.7	4.
20	0.90	34.93	4.55	80.8	40.
30	1.81	294.54	5.29	507.6	393.
40	4.25	1060.01	6.66	2335.2	1807.
50	4.87	1691.41	2.49	6888.7	5329.
53	5.00	1858.99	14.24	8623.6	6671.
60	5.91	2251.5	17.97	13190.2	10204.
70	6.66	2817.0	23.14	21203.0	16402.
80	6.75	3300.0	29.0	31125.7	24028.

NOTE. The present water level is 53 ft. above zero The lower part of the table shows the proposed extension.

The dam cost $75,000. The teaming bill was very large, as it took each team from 10 to 12 days to make the round trip. We had all the teams in the county from the big desert freight teams of 16 or 18 mules to the little 2 horse team. I kept my force of men of such a number as to just keep up with our supply. I rarely had more than 1 or 2 days supply of cement on hand, yet never ran out, though one noon, when the men went to dinner, there was just one hour's supply on hand. Fortunately some arrived while the men were eating. It was my aim to get the dam high enough before the floods of winter came, to let the surplus water flow out of the waste



The Bear Valley Dam. F. E. BROWN, Engineer.

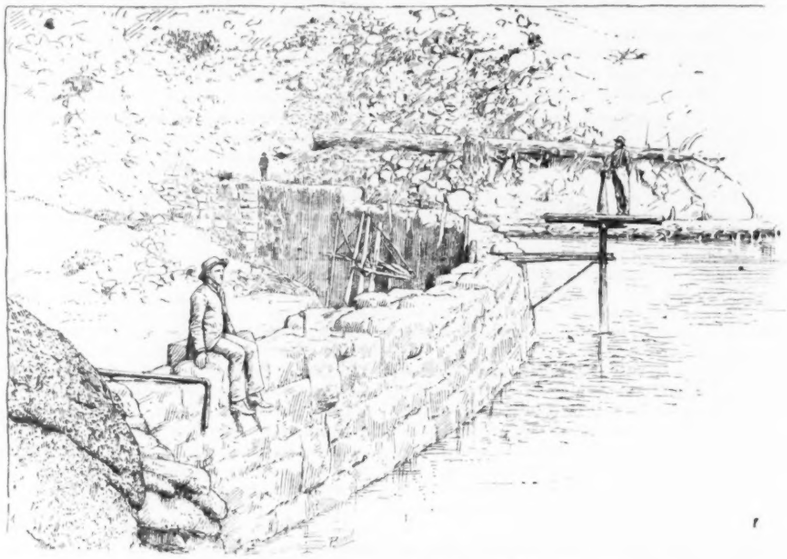
weir, as I did not wish to have it pour over the top of the new dam. But I let the water follow the dam up rapidly as we built it in order to bring the pressure to bear upon the arch before the cement was set very hard, and thus to let the whole arch take its bearings, and transmit the pressure to the mountains at the ends.

Being built thus, it is difficult to detect any movement of the wall on account of the pressure. The dam proper is part of a cylinder set on end, and a stone dropped from the top falls to the foundation as plumb as ever it did. Of course there was some seepage through the dam, but this is gradually decreasing. There were also some fissures in the hard, solid rock at south end, through which some water works out.

It is our intention to begin again, and build up to 80 ft. as per contour map. This we shall build on a curve but with a gravity section, which I think is the correct form and way to build a perfect dam. This section of the country has grown very rapidly in the last 4 years, and we can now do work that would have been impossible then. I graduated in the Class of 1876 at the Yale (Sheffield) Scientific School, came to California in April 1877, and have given my attention to Hydraulic Engineering and Irrigation ever since. Southern California with water is a a garden, without it, a desert.

While on a recent trip around the world I visited the Hong Kong dam, of the Tytam Water-Works, under the charge of Mr. ORANGE, a very fine and pleasant engineer. It is a good dam with many points of interest. Yours respectfully.

F. E. BROWN.



The Bear Valley Dam. F. E. BROWN, Engineer.

A Recent Trip over the Panama Canal.

PANAMA, June 2, 1888.

EDITOR ENGINEERING NEWS:

Perhaps a few words from an old subscriber, and from a region which has recently attracted so much attention, may not be unwelcome to you and your readers. At all events I shall risk it.

On May 21, Col. N. B. LORD, Mr. O. F. WHITFORD, C. E., and myself, left New York in search of "fresh fields and pastures new" for engineering enterprise, of which perhaps more anon. We arrived at Colon May 29, and came at once over to Panama; and while waiting for another steamer, Col. A. L. RIVES, of the Panama R. R., an old ex-Confederate friend of mine—at one time Assistant Chief Engineer of the C. S. A., sent us free passes over the P. R. R. for "auld lang syne's" sake, and invited us to return to Colon at our pleasure, offering us all possible facilities at his disposal, for seeing the great "Canal Interocéanique". In obedience to his kind invitation we went to Colon day before yesterday, leaving Panama at 8 o'clock, and arriving at our destination at 10.20 A. M. We found Gen. D. H. MAURY, our Minister to Colombia, waiting for us at the railway station, who had been our *compagnon du voyage* from New York. With him we went to the Headquarters of the American Contracting & Dredging Company, where all arrangements had been made for the proposed trip, by Mr. T. J. CULLITON, the company's Superintendent. Mrs. CULLITON, the beautiful and intelligent wife of the superintendent, likewise became a member of our party. Thus organized, the inspecting party, whose official reporter I am, stepped aboard a fast New York tug, which the Dredging Company uses as a dispatch boat, and in a few minutes had passed out of the *boca del canal* into the main channel. At the rate of from 12 to 13 miles per hour we sped along between the low level banks which border the canal for the first 8 kilometers. For this distance we saw nothing of interest, so far as canal work is concerned, except an occasional *plaquet* which we met. These *plaquets* are large iron mud-scows having their own locomotive machinery in the rear, and with the forward part self-opening for dumping purposes. They are now being used by a French contractor for carrying rocks and mud beyond the Colon mouth of the canal; the rocks and mud with which they are loaded being excavated by blasting and dredging, in the operation of deepening the canal at several points where the American dredges have not brought it to the specified depth. The American company's contract covered earthwork only, the Frenchman's included all rock excavation. To an outsider it looks like a great waste of labor to transport this material so far, (we saw it going about 10 miles), but of course, one who does not know all the conditions should criticise with care

About 8 kilometers from Colon the canal first crosses the Chagres river. At this point our boat turned out of the canal into the river, and in a few minutes brought us to the Dredging Company's coal yard, store houses, and workshops, the extent and completeness of all of which took us completely by surprise. If you will get a set of catalogues of hardware, plumbers' goods, ship chandlers' materials, carpenters' and smiths' tools, groceries, house furnishing articles, drugs and medicines, then add a full description of an elaborate machine shop, a foundry, a boiler shop and a saw mill, you will have what I should be compelled to write to give you an adequate idea of this company's outfit. And it was all in perfect system and order, in marked contrast to what we had observed all along the line of the canal where the European contractors are at work.

After a half hour's examination of the shops we returned to the canal, and continued our upward journey. At about 11 kilometers from Colon we came to the French party who were engaged in the submarine blasting and filling a *plaquet* with a dredge. This was t the "Mindi Cut", the first place where anything like high banks had been encountered. [There is some error here; the Mindi Cut is at Kilo. 5½. ED.] Passing by the Frenchmen without stopping, we soon came in sight of one of the great Slaven, or American dredges. Doubtless you have described these huge machines before, so I will not attempt it. If your readers will imagine the Pennsylvania R. R. elevator of Jersey City, floating in a channel 200 ft. wide, with great booms standing up on either side at an inclination of 60°, and these booms, by numerous wire cables, holding out two wrought-iron pipes, 3 ft. in diameter, each 180 ft. long, through which pipes a continuous torrent of mud and water is pouring out on the two banks of the channel—then add the black smoke rolling from three huge smoke-stacks, and the roar and rattle of an immense boiler shop with dozens of trip-hammers at work at once—they will have a fair conception of this titanic toiler, gnawing its way through the link which binds together two continents.

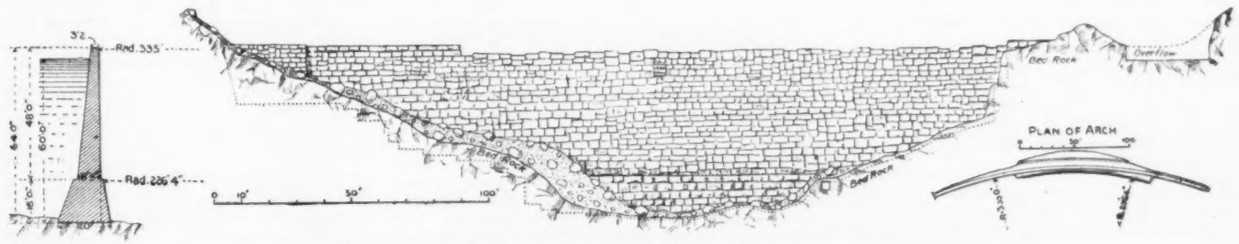
We inspected it thoroughly from top to bottom, and a fuller acquaintance with the monster only increased our wonder and admiration of its skill and power. This was the dredge "City of New York", which was engaged in bringing a portion of the canal, which had already been partly excavated, to its full depth. We passed on up the canal, and at a point about 18 kilometers from the mouth we came to a new and still more interesting feature of the work. This was at a point where the American company had encountered land so high that they

The Weather of the United States for the Month of May, 1888.

[As respects the elements of most interest to engineers.]

According to special returns from the Chief Signal Officer of the U. S. Army.

STATION.	Temperature. Degrees Fah.				Wind Velocity. Miles per hour.			Precipitation. Rain and melted snow. Inches.		
	Average	Max.	Min.	Range.	Average	Max.	Direction. Max.	Total.	Heaviest in 24 hours.	No. rain days.
Northern Cities.										
Northfield, Vt	56.6	77.2	24.5	52.7	8.7	30	SW & S	3.51	0.63	17
Portland, Me	48.8	66.6	32.3	34.3	6.4	25	E & NW	3.36	1.38	12
New York City	57.9	82.1	40.7	41.4	9.2	34	NW	4.87	1.69	21
Pittsburg, Pa	61.4	85.2	37.2	48.	6.9	32	W	4.13	1.01	18
Chicago, Ill	52.6	81.	32.2	48.8	10.1	44	SW	6.22	2.43	16
Omaha, Neb	55.9	84.	36.7	47.3	8.9	29	NW	4.36	0.94	16
St. Paul, Minn	49.8	77.5	28.6	48.9	6.2	26	W & NW	4.75	1.23	19
Duluth, Minn	42.2	70.	25.4	44.6	6.9	26	NE	4.12	1.22	13
Bismarck, Dak	49.2	73.9	20.	53.9	9.9	48	NW	0.70	0.37	9
Average	52.7	77.5	30.8	46.7	8.1	32.6		4.00	1.21	15.6
Southern Cities.										
Washington City	63.0	89.	39.	50.	5.	27	SW	4.77	0.74	17
Louisville, Ky	65.2	90.8	37.5	53.3	7.9	30	SW	2.42	0.68	18
St. Louis, Mo	63.1	87.5	40.	47.5	11.6	46	S	3.81	1.05	12
Savannah, Ga	72.5	99.6	53.5	38.1	7.6	24	E	3.60	1.14	9
Leavenworth, Kan	60.5	89.8	36.5	46.3	7.0	30	S	7.70	2.60	13
Jacksonville, Fla	74.2	93.	56.5	36.5	5.6	29	W	5.46	1.39	15
Chattanooga, Tenn	66.9	87.8	39.8	48.	5.5	23	E	4.91	2.99	16
New Orleans, La	72.8	88.5	60.	28.5	7.0	48	NW	9.75	1.97	12
Memphis, Tenn	69.0	88.	46.	42.	6.0	30	NW	2.35	0.91	11
Palestine, Tex	70.5	88.3	48.6	39.7	8.2	48	NW	6.64	1.46	12
Average	67.7	88.6	45.6	43.	7.1	33.5		5.14	1.48	13.5
Western Cities.										
Helena, Mont	50.0	78.	31.	46.	7.8	33	SW	2.96	1.08	22
Port Angeles, W. T				Not yet	received					
San Francisco, Cal	55.4	81.1	47.4	33.7	10.1	29	W	0.38	0.19	5
Salt Lake City, U	58.6	84.	38.1	46.9	6.1	28	W & NE	0.34	0.09	8
Denver, Col	53.2	85.	31.5	53.5	6.9	36	N	2.66	0.82	20
Yuma, Ariz	76.9	102.	54.	48.	5.6	26	W	0.	0.	0
Santa Fe, N. M	53.4	76.5	33.5	43.	7.0	33	W	0.70	0.37	7
Average	57.9	81.4	39.4	45.	7.2	30.8		1.17	.42	10.3



Plan, Section and Elevation of Bear Valley Dam. F. E. BROWN, Engineer.

were compelled to make two through cuts. To accomplish this they first excavated with scrapers, dump cars and smaller machinery, a channel just deep enough to float their dredges—8 ft.. if I remember rightly. Into this the dredges worked a short distance, then a dam was thrown up behind them, then the upper channel was filled with water by pumps taking water from below the dam. And now three of the dredges are on this upper level digging a channel which will be 22 ft. deeper than it now is, and so much below the water surface of the lower level that the dredges will float when the dam is cut. Then another cutting will put the canal to its specified depth, and 22 kilometers will be finished to a depth of 28 ft. below mean tide of the Atlantic side. This will terminate the contract of the American company. They expect to get all this work done in four months more, and at their present rate of progress there can be no doubt of their ability to do so.

So much for this part of the great undertaking, which has undoubtedly been executed with characteristic Yankee skill and energy. Had all the work on the canal been as systematically and as intelligently executed as that which I have just described, the whole scheme would present a very different aspect from what it does at present. But the past is dead and gone; it cannot be recalled; and nothing is so bootless as "might have been." Let us turn rather to the present and to the future of this vast enterprise.

It is not my intentions to enter into details, and give you a formidable array of facts and figures—even if my cursory examination of the rest of the canal work would enable me to do so, which I am free to say it does not. I will simply make the following statement of facts and conditions, which I got mostly from Col. A. L. RIVES, who is thoroughly posted on all canal matters, and who has but recently returned from France, whither he went on business relating to both the canal and Panama R. R. It has been definitely settled that the canal will not be a level one from ocean to ocean; there will be 8 [10, ED.] locks, four on each side of the summit level, of 24 ft. lift each; [27 to 37 ft. each or 163 ft. lift in all instead of 96 ft. ED.]. This will save an enormous amount of excavation and costly auxiliary work. It will also add the cost of the gigantic locks and their accessories, but there is still a vast saving both in time and money. It is estimated that $125,000,000 more will finish all the work to be done, with the lock system adopted, and 4 years more is considered ample time to accomplish this work. The contracts for all the locks are let, and the work of preparing the beds of foundations for them is actively going on here, while the iron work for the locks is rapidly being made in France by M. EIFFEL, the greatest of modern constructors. The adoption of the lock system has inspired new hope and energy in all parties interested, as it establishes the feasibility of the whole scheme. It is believed that the lottery scheme will be approved by the French Government; and if it is, there is no doubt but that the requisite funds can be raised to complete the work.

Col. RIVES thinks that 50 per cent. of all the work has already been done. This includes all the auxiliary and false work, which has hitherto taken up so much time, and been so costly, but which is now all available for actual canal work, with but little future increase of expense on this particular account.

So much for the bright side of the picture. I will, add a few darker touches from my own observations. No one can travel over the Panama R. R., which throughout over half of its course runs close alongside the canal, without being struck by the tremendous extravagance which has hitherto characterized all operations here, except those conducted by the American Company. Millions of dollars have been expended in numerous, costly and elaborate buildings, thousands of which seem now to be unused. Even greater millions have been wasted in vast piles of machinery which literally choke up the course of the canal. Quantities of it have never been used but are wearing away by rot and rust in disuse; other vast quantities have been misused, and abused, and abandoned. A great deal of work has been done, which has proved unavailing and futile, by reason of subsequent changes of plan. Taking all these things into consideration one cannot but have misgivings. But when so good an Engineer as Col. RIVES says that everything is on a much better basis now, perhaps we may be justified in falling in with the feelings of hope, and the brighter anticipations which are manifest on the Isthmus.

A few words in regard to the Panama R. R., and I am done. Under Col. RIVES administration the road has earned $1,000,000 more in the last 12 months than it did in the year preceding. The road is now earning $75,000 per mile per annum. In spite of the tremendous wear and tear the canal operations subject it to, it is in fine condition. It is a crooked road, and has some steep grades, yet trains making 40 miles per hour are run every day. There are 3 regular passenger trains each way every day, and from 20 to 30 freight trains. The railroad and the canal company are working in perfect harmony with each other; in fact the canal company owns $\frac{8}{10}$ of the railroad stock, and while the two administrations are nominally independent, they are actually working together to the same great end, namely, the completion of the canal.

Yours truly, S. H. LOCKETT, C. E

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D. McN. STAUFFER. A. M. WELLINGTON.

EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

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Brief Technical Notes *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

American Railway Master Mechanics' Association In session at the Thousand Islands, N. Y. Secy. Angus Sinclair, Chicago.

American Society of Civil Engineers, New York.—Annual Convention at Milwaukee, Wis., commencing June 28. Secy., John Bogart, 127 E. 23d St.

American Association for the Advancement of Science. The thirty-seventh meeting will be held at Cleveland, O., from August 15 to August 21, 1888. The headquarters will be at the Holl-nden. For particulars address F. W. PUTNAM, Salem, Mass.

Engineers' Club of Kansas City, Mo.—Regular meeting, July 2. Secy., Kenneth Allen, 19 Deardorff Building.

Civil Engineers' Society of St. Paul, Minn. — Regular monthly meeting, July 2. Secy., Geo. L. Wilson, City Hall.

Ohio Institute of Mining Engineers.—Summer meeting at Logan, O., July 11, 12, 13. Pres., W. H. Jennings, Columbus; Secy. R. S. Weitzel, Kittanning.

New England Roadmasters' Association. — The 6th, annual meeting will be held at Boston, Mass., August 15, 16. Secy.: W. F. Ellis, Roadmaster, Providence & Worcester R. R., Woonsocket, R. I.

Roadmasters' Association of America.—Next meeting at Washington, D. C., Sept. 11. Secy., H. W. Reid, Waycross, Ga.

THE interesting letter from Col S.H. LOCKETT which we print elsewhere, describing a recent trip over the Panama Canal, will be read with some amusement by those who have followed the matter on this subject which we have recently published. Col LOCKETT evidently did not have the advantage which our readers have enjoyed—seeing an actual progress profile—nor was he able to obtain very accurate information as to what the lock plans were,—although he has been in the precise region where one would expect such exact information to abound. His trip "over the canal" was confined to that part of it which is on exhibition, and well may be—the part executed by the American Dredging Co., which appears to have handled its work throughout in thoroughly systematic and economical manner, to have lived up to its engagements, and to have been extremely judicious in making its contracts with the company, especially in contracting only for earth, leaving the rock to the tender mercies of the Frenchmen, so that it has made a great deal of the money. For all the remainder of the work Col. LOCKETT "simply makes the following statement" which he "got mostly from Col. Rives", Supt. of the Panama Railroad, who had "returned recently from France", sample extracts from which are that there were to be 8 instead of 10 locks, of 24 ft. instead of 37 ft. lift each, and 96 ft. instead of 163 ft. total lift. After thus giving the bright side of the picture, as was becoming in a guest of the canal company, Col. LOCKETT devotes a few words to "darker touches from his own observation", which certainly tend to justify his own conclusion that "taking all things into consideration one cannot but have misgivings", which is our conclusion likewise. If the American Contracting & Dredging Co. could be induced to take and sign a contract for the entire canal we should expect to see it go through, for we do not believe that they could be induced to touch it unless they saw their way through it, but the heavy end of the work as an engineering problem has hardly yet been touched, and under the present management we cannot believe that there is the slightest rational probability that the canal will ever be opened.

THE *Evening Post*, in discussing the information we have lately given as to the Panama Canal, and especially Mr. SNOW's letter in our issue of June 16, says:

"But what we find most remarkable in Mr. SNOW's letter and confirmed by official cross-sections copied from the contractors' drawings (Fig. 1 of the *Engineering News*), is the statement that the Dutch firm 'had contracted to take out all material above elevation 50 m., from kilo. 53,600 to kilo. 55,460.' This was at the beginning of 1885. The distance was about a mile and a quarter in the center of the summit. According to the present plan, the summit-level is to be 49 metres high, or 1 metre lower than the Dutch contractors were to excavate, and to extend from K. 50 to 55. Were the engineers of the Panama Canal getting ready for the lock system in January, 1885? Mr. SNOW says, 'The Dutch contractors did very little in 1885; they were considering whether to go on or not in 1886.' It was in 1885 that M. DE LESSEPS first asked the French Government for authority to issue a lottery loan. It was in 1886, when the Chamber of Deputies wished to examine his contracts, that he withdrew his application, and had recourse to his 400,000 stock and bondholders. In that year and the next he made two issues of the par value of $142,500,000, for the purpose of completing the sea-level canal. It was not until December, 1887, when the money thus raised was nearly exhausted, that the project of making a canal with locks was publicly avowed. In the meantime, as Mr. SNOW says, 'three dry seasons had been lost.' Sympathy for this enterprise or its promoters seems out of place."

It certainly looks very much as if the purpose to contract a lock canal had been formed at least two years before it was officially announced, and it is certainly more creditable to the intelligence of the managers of the canal to suppose so, if not to their honesty and good faith.

OUR attention has been called to the fact that while our list of loans for the Panama Canal, in our editorial of June 2, is correct, the estimate given of the cash realized is not, but is considerably too small. The figures given by the *Weekly Bulletin* (the stock-brokers' official list, of Paris), for the week ending Nov. 12, 1887, are as follows:

Issue.	Number.	Price.	Amt. re'liz'd
			francs.
Capital Stock	600,000	$500	300,000,000
Bonds 5 %	250,000	437 50	109 375,000
" 3 %	600,000	285	171,000,000
" 4 %	477,387	333	158,969,871
1000 fr. bond			
" "1st series	458,802	450	206,460,900
" "2d series	258,887	440	113,910,280
Total realized to Nov. 1887			1.059,716.051
Or in United States currency			$211,943,210

Now in his letter to the Prime Minister (Nov. 17, 1887) M. DE LESSEPS said that, after paying the January (1888) coupon, there would be left in the company's treasury $22,000,00 On March 14, 1888, the company sold 108,232 bonds (of 1,000 fr. par) at 460, netting $9,957,344, making the total $221,900,554, cash realized. Of the $22,000,000 on hand January 1, and $9,957,344 collected in March, M. DE LESSEPS wrote the Chamber of Deputies in April, that he was spending it at the rate of $4,000,000 to $5,000,000 per month, and 6 months have passed by since that date.

These facts make a statement which appeared in the *Economiste Francais*, of May 26, 1888, of no little interest. It was:

"The needs are pressing. Not content with the 100 millions that M. DE LESSEPS said he had at his disposal after the January coupon, and the 40 millions not that the last loan brought him, he borrowed last week from credit companies 30 millions, making 170 millions that the Company will have eaten up in six months."

The company has certainly a great appetite for cash.

WE are pleased to be able to announce that subscriptions to the KUTTER fund which we have been endeavoring to raise, in coöperation with a few engineers who take a great deal of interest in the matter, have come in much more liberally this week. The Engineers' Club of Philadelphia has subscribed $100 as a body. The New York branch of the German-American Technical Society has subscribed $94 by individual subscriptions, as below acknowledged; and more is promised, both from the New York and the other branches of the Society. Other individual subscriptions have raised the total for this week to $227, and the total so far subscribed to $323, as follows:

Previously acknowledged		$ 96.00
Engineers' Club of Philadelphia		100.00
T. Kondo		3.00
V. Weber		5.00
Wm. R. Hutton		20.00
B. . Randolph		5.00
Members New York Branch, German-American Tech. Soc. as follows:		
Augustus Kurth	10.00	
Paul Goepel	5.00	
E. A. Giesecler	5.00	
H. Doerflinger	5.00	
H. N. Fabian	5.00	
E. Veltfort	5.00	
C. Kirchoff, Jr.	5.00	
W. Hildenbrand	10.00	
Max C. Budell	5.00	
E. L. Heusner	5.00	
P. Schmaltz	2.00	
J. E. Hintze	2.00	
R. Stricker	5.00	
Charles Zoller	3.00	
A. Pfund	2.00	
A. H. Raynal	5.00	
H. B. Rœlker	5.00	
W. Paul Gerhard	5.00	
G. W. Wundram	5.00	94.00
Total to date		$323.00

A very little effort, and a very little additional generosity will raise this amount to $1,000, which is little enough for America to give to the widow of Mr. KUTTER in acknowledgement of his services to science. To be sure, if abstract justice were to prevail, this amount would not all come from the pockets of engineers: but abstract justice rarely does prevail in this sorrowful world, and it is only to engineers that an appeal can be effectively made. Therefore, we hope that every engineer who appreciates the value of eminent and successful efforts in the cause of science, and is unwilling to see the widow of one who has made them oppressed with care, will open his heart and send in at least $2, while there is yet time.

THE *Railway Review* of June 9, under the head of "Locomotive Performance and Cold Weather" remarks that "We have had upon our desk a matter to mend for some time", and then proceeds to reprint almost in full a letter from Prof. KLEIN of Lehigh University, which appeared in our issue of Dec. 8, 1887, relating to some experiments of his on locomotive radiation, and our discussion of them in the following issue. Our esteemed contemporary appears to think that it can score a point by first assuming that Prof. KLEIN has some cudgels to take up, which we have rea-

son to know is not the case, and then attempting to take them up, which it does in this fashion:

"Now we are familiar with rolling stock, and coal consumption, and familiar with the statements made in the work on railroad economics referred to [Mr. WELLINGTON'S "Economic Theory of the Location of Railways," where on p. 137 there is given, 'a rule deduced by the writer from records covering many millions of train miles, *that the effect of differences of temperature alone, length of train and all other conditions being equal, is to increase or diminish coal consumption at the rate of* 1 *per cent. for each two degrees Fahrenheit* (and a small fraction more) *difference of external temperature*; a rule easily remembered and one which appears to apply fairly well to both passenger and freight service, and to be practically invariable whenever the effect of all other causes for variation can be estimated',] and we most emphatically disagree with such statements as are therein made. No master mechanic or other railway official will believe that the fuel consumption varies 1 per cent. for each two degrees of variation of external temperature, even if all the books in creation were to assert it."

Our contemporary then proceeds to prove its case by an example as follows:

"The summer temperature of the Western prairies is often 100°; that of winter is about *(sic)* 20° below zero [We presume our contemporary means, is occasionally −20°. ED.] Now, if Mr. WELLINGTON'S statement be accepted, this will result in an increase of fuel consumption of 60 per cent., due to differences of temperature alone."

It will, esteemed contemporary; that is precisely what it will do, deducting about 10 per cent., so as to correspond with the formula as given above; that is to say, a sufficiently careful test with the same train under these extreme conditions, with all other conditions equal, will show the coal consumption for the same work done (say 10,000 miles run with 20 cars) to be about as 1.0 to 1.5; and no "master mechanic or other railway official" who will first investigate the facts with the care that he should, will undertake to question it. Because a book of 1,000 pages was not loaded down with 20 or 30 more pages of the evidence on which the law rests, it must not be assumed that it does not exist, and may not be found by any others who are really "familiar" with the subject. We suggest to our contemporary, in all kindness, that it is a good plan to investigate first and talk afterwards, and not put too much faith in an inner consciousness of what "no master mechanic will believe."

THE same article from which we have just quoted makes the statement that "observers, in the coldest weather, who have ridden in a dynamometer car back of a locomotive, can see no appreciable difference in the amount of car resistance whether the weather be cold or warm, provided the other conditions be the same." Sufficiently reliable evidence as to whether this is so or not would be a great contribution to knowledge. Of course passengers in a dynamometer car, whether in charge of the instruments or not, cannot tell anything about what can be "seen" from the diagram until elaborate computations and corrections have been made, but records of such corrected tests, corrected so as to be fairly comparable for the effect of temperature, would be of great interest. We do not believe that they exist, and doubt if they can be obtained in any other way than by gravity tests, since the dynamometer car appears to be subject to erratic variations which cannot be eliminated, and hence is not precise enough for such a purpose. Thus, in some C. B. & Q. tests recorded in our issue of Aug. 13, 1887, the original records of which we have examined, and which we are confident were as correct as a computation could make them, the resistance of several empty car trains was found to range above 12 lbs. per ton at 20 to 25 miles per hour, while loaded car trains at the same speeds range between 5 and 6 pounds per ton. The last is about right, but the first is certainly excessive by some 4 lbs. per ton. Numerous instances of such lawlessness may be found in the records of dynamometer tests, and few or none of any series of consistent tests.

But a difference of resistance which it would be difficult to detect in a single test would be quite enough to make an enormous difference in the winter coal bill, since it is cumulative and always acting. Thus, 2 lbs. per ton extra resistance wastes in a 30 ton car $30 \times 5280 \times 2 = 316{,}800$ ft.-lbs. per mile, which, $\div 772 = 410$ H.U. Taking the specific heat of iron at $\frac{1}{9}$, this will heat up 3690 lbs. of iron 1°, or 1845 lbs. 2°, in one mile, say 4 minutes. There is fully the latter weight of iron which can be conveniently heated by conduction. It would be the easiest thing in the world to radiate that amount of extra heat in winter weather. Now the locomotive is doing very well which generates a horse-power per hour with 4 lbs. of coal in every day winter service, or 495,000 ft. lbs per lb. of coal. Hence the above loss, if it exists, means the loss of $\frac{316800}{495000}$ = about $\frac{2}{3}$ lb. of coal per car-mile, added to an average consumption of perhaps 4 or 5 lbs. There is a great loss of coal for a small amount of heat, because all heat radiated from the train behind the engine is not supplied again from the firebox, but must be supplied by the reconversion of energy into heat, and the creation of this energy involves the throwing away unused of 90 to 95 per cent. of the heat generated by combustion. It will be seen how wide a field this inquiry opens into, but we cannot now follow it further.

THE interesting communication from F. E. BROWN, Engineer of the Bear Valley dam of California, gives some details of the work which will be read with general interest, especially as explaining how the dam came to be built of such a pronounced arch type, having no gravity stability whatever. It was a question of a bold dam or none at all. The dam is, doubtless, the boldest one in the world, and its construction has been a valuable contribution to engineering, but few men would have cared to chance it except under the spur of some such necessity as that laid upon Mr. BROWN, and it is eminently prudent that in increasing its height from 53 to 80 ft., the pure arch type should be abandoned, and resort be had to the curved gravity type. We have little doubt, however, that, even in the new dam, so much reliance will be placed upon arch action as to give the dam a somewhat bolder section than would otherwise be required for a proper margin of safety, and this, we believe, it is entirely safe to do, since the first beginning of incipient yielding from any cause, normal or abnormal, throws the dam into compression and generates arch action, instead of tending to open the joints as in a straight dam.

The dam is so thin on top (38 ins.) that it would be quite out of the question, to extend it as an arch 27 ft. higher, even if it were a defensible experiment to do so.

WHEN masonry becomes unsafe, so as to demand renewal, and when it may just as well be left to stand even if it has settled and cracked more or less, with or without further precautions against accident, in case of sudden failure, is one of the most delicate questions which come before the engineer. Especially if his experience be limited, he is sorely tempted to order out such a structure at once, for he is acting on the safe side in declaring it unsafe, and there is little probability of any one's daring to dispute his judgment, or if they do, they are the ones who put themselves in the unfavorable attitude of rashness and carelessness, and not he.

Yet if every such structure were taken out as soon as it showed signs of settlement or weakness the maintenance account would be enormously swelled, while many of them are really stronger after the settlement than before, especially if it be found that after reaching a certain point the settlement stops, and especially if it is possible to so protect the track or roadway or aqueduct that no great harm can result even should the structure suddenly give way. Certainly, when this has been done, no one can be justly reproached for postponing for a time complete reconstruction, carefully watching the course of events; and if no further change takes place in months or years, in postponing it to some entirely convenient season, or until further necessity appears.

THIS is precisely what has been done in regard to a 20 ft. arch culvert, 18 in. ring-stones, rising to within 4½ ft. of the track, a few miles out of this city, on one of the prominent trunk lines. We received some time ago a photograph of this structure with a letter stating that "though the arch has stood heavy traffic for many years, it appears liable to fall in, and with fatal results, at any time", and asking "why such structures are allowed to remain on a "would be" first-class railroad with very large and important passenger traffic". As is our practice when probable reason appears, we made further inquiries before publishing the letter, and find that the track was long since supported on heavy wooden stringers underneath the cross-ties, so that even if the arch were to suddenly give way altogether, no harm to any train could result. This being so, and the failure not being such as to seriously weaken the arch if it goes no further, the structure is entirely safe, and it is a mere question of operating economy whether to renew it at once or not. Such defects stand on an entirely different basis from the signs of incipient weakness in iron or timber structures, or in culverts under deep fills whose sudden failure would choke the water passage, and produce wholly unforeseeable effects.

In the meantime it appears that our correspondent sent the same letter to another technical weekly which publishes it in full, attacking the road by name, with a picture of the culvert which is supposed to be ready to fall in, but with no mention of the fact that this possibility was long since detected and effectively guarded against, which was perhaps unknown to the writer, and with the apparent idea that the condition of the structure was probably unknown to the management. The error, no doubt, was in assuming that such appearances necessarily indicated danger and could not be guarded against effectively, as would be the case in some kind of structures, and with some kinds of failures; but it is none the less a wrong to the officers and the company whose reputations are attacked, to publish such matter except understandingly.

THE convention of the Master Car Builders Association this year has not been one of its notable ones. Nothing of especially great interest was accomplished, and the selection of a site was rather an unfortunate one, since, however picturesque it may be to have the hall for meeting on an island, only to be reached by a voyage from the hotel, it has a tendency to discourage attention to business and encourage attention to sociality and junketing, of which there is apt to be enough at best, and very naturally. Perhaps it is even, for many, as good a use as can be made of the time, at this season of the year. Various very good reports were presented, some of which we present this week and others of which we shall later.

Railway Construction in 1888.

The mileage of railway construction in the United States since Jan. 1, 1888 to the present time, or practically for the first half of the current year, is 2,312 miles, which is summarized by States and sections in the following table:

STATE	No. LINES	MILES	STATE	No. LINES	MILES
Canada	3	17	Illinois	6	120
			Wisconsin	2	28
Massachusetts	1	2	Minnesota	2	27
New York	3	20	Nebraska	3	79
New Jersey	1	6			
Delaware	1	11	*Tot. Northwest*	13	254
Maryland	1	1			
Pennsylvania	3	19	Missouri	6	163
Ohio	3	44	Kansas	3	103
Indiana	1	10	Indian Ter.	1	48
Michigan	3	88	Arkansas	2	39
			Louisiana	3	64
Total East of Chicago	17	201	Texas	4	72
			Tot. Southwest	18	489
Virginia	2	24			
North Carolina	7	81	Montana	3	66
South Carolina	3	48	Idaho	1	7
Georgia	4	250	Wash. Ter.	2	13
Florida	4	35	Oregon	2	52
Alabama	9	158	California	12	207
Mississippi	1	15	Colorado	2	43
Tennessee	7	128	New M'xico	1	85
Kentucky	4	156			
Total Southern.	40	895	*Tot. Rocky Mt. & Pac.*	21	473

Grand Total, United States, 109 lines, 2 312 miles.

While the above is a large showing for the first half of the year, it should not be concluded therefore that the mileage of new construction for the whole year is likely to be unusually large. We have often taken occasion to point out the fallacy of the great expectations which some of the over sanguine ones have indulged in, with reference to the probabilities of railway construction. For example, the prophecy made a fortnight ago by one of our contemporaries in the railway field that, "the total for 1888 is well nigh certain to exceed 8,000 miles, with a likehood that it will reach 10,000 miles, and a possibility that it may not fall short even of 12,000 miles", will undoubtedly prove a guess wide of the mark.

A study of the list of the new lines built thus far in 1888, published elsewhere in this issue, shows that nearly 2,000 miles out of the whole 2,312 were graded and ready for the rails by the close of 1887. To say therefore, that because this mileage, which was planned, surveyed and graded under the stimulus of prosperity which prevailed in 1887, amounted to 2,000 miles, hence the new construction for the remainder of the year is likely to reach 8,000 miles seems very poor logic. If we are to properly judge of this year's work from that of past years, we must go about it in a different way. Turning to the map in our last week's issue, note the long extensions which formed the principal part of the new construction of 1887. At this time a year ago, *every one* of these long extensions, with the sole exception of the Illinois Central's line from Sioux Falls, Dak., to Onawa, Ia., was well under way. The 650 mile extension of the St. Paul, Minneapolis & Manitoba, the Atchison, Topeka & Santa Fé lines to Chicago, to Fort Worth, to Los Angeles, and to Denver aggregating 750 miles; the extensions of the Rock Island, Missouri Pacific, Chicago, Burlington & Quincy, Ft. Worth & Denver City, St. Louis & San Francisco, Minneapolis, Sault Ste. Marie & Atlantic and others aggregating at least 8,000 miles, were all in the hands of contractors, who were everywhere actively engaged, with no time to hunt up jobs. Are such conditions in force now? Everyone knows they are not. The great systems which, as shown by our last week's diagram, built over 9,000 miles, or nearly three-fourths of all last year's work, are now, we may say, doing almost nothing. The Manitoba is now laying track on two lines which were graded last year. The Sault Ste. Marie & Atlantic managers are delaying the completion of the line which they graded last year to Bismarck, Dak. The Burlington managers have been through enough this year in the way of strikes and rate wars, without touching their surveyed extensions. The Santa Fé will likewise leave its projected extensions severely alone for the present, and most of them are short lines. No one pretends to have an idea of what GOULD will do with his Missouri Pacific, but thus far there is no indication that any extensions of importance are intended at present. The Rock Island alone is keeping up to some extent its construction work, and its Colorado extension is absolutely the only line of any great length which is now under construction.

It is not without good reason that railway construction in the Northwest has come to a standstill. The long rate war which has been more or less active for the past five months, has not been compensated by any increase in traffic. The enmity of the public to the railways in Iowa, Minnesota and Nebraska bids fair to result in grave financial trouble to the corporations involved, and there is a very general feeling that until the railways of the Northwest learn to treat each other with some fairness and justice, and until they receive fair and just treatment at the hands of the legislatures and courts, there should be, and probably will be, a cessation of active railway extension here.

Where our contemporary is to collect the remaining 8,000 miles of work to fulfill its confident prophecy, we contess we are at a loss to see. There are projects enough on paper—there always are—and a great many miles are staked out; but of actual construction now in progress in this country there is very far from being 8,000 miles, and the actual probability of the total construction for the year, instead of being 10,000 miles,as our contemporary puts it, is about half that figure. That is to say, there will probably be built, during the next six months, about 3,000 miles of railway lines, making not over 5,500 miles in all.

An examination of the map, in our issue of June 16, aids us greatly in determining where the principal part of this new construction will take place. Almost all the lines built since January 1 are seen to be in the South and Southwest.

This is partially due of course to the fact that grading and tracklaying can be carried on in that section even better in the winter than in summer, while work in the North must generally stand still in the winter months. But a fact of more importance is that the States south of Mason & Dixon's line and the States of Missouri, Arkansas and Louisiana are still very deficient in railway facilities in proportion to their natural resources. These States then, and especially such sections as have been most remote hitherto from the railways, will furnish a large part of the construction for the remainder of the year.

The States east of Chicago will, as usual, contribute a fair number of short extensions and branches; and there are prospects that portions of new east and west trunk lines, like the South Pennsylvania and the New York, Mahoning & Western, will reach partial completion this year.

Another region which promises considerable activity is the Pacific Coast and the Territories. Washington and Oregon have been especially backward in growth; but the present indications are that their fertile area, mineral wealth, and timber lands are now to be rapidly developed. California has already laid 200 miles this year and promises well for the future. Montana and Wyoming seem likely to follow close on to Washington Territory; and Arizona and New Mexico may add something to the total.

If we can judge of the prospects in Mexico by the number of projected enterprises which English and American capitalists are furthering there, that country promises to be a good field for a moderate number of engineers and contractors for some time to come. In Mexico as in the United States, however, railways are more easily built on paper than on the ground.

In Canada, while there is considerable work projected in the eastern Provinces, the main center of activity will be Manitoba and the Northwest Territory. The people have at last won in their fight for an outlet over the United States lines, and the famous Red River Valley Railway will be only the first of a number of lines to the boundary. The great Peace River Valley in the far Northwest, comprising 1,260,000 square miles, is the greatest area of fertile land awaiting railway development on the continent; and some of the various projects for entering it with railway lines will probably be put into execution before long.

It should be understood that our estimate of 5 500 miles as the probable construction of the year, refers only to the United States as did our contemporary's estimate of 10,000 miles. While speaking of our contemporaries, we may note that another journal,ambitious to be esteemed an authority on statistics of railway construction, recently (June 1) published a list of "track laid between Jan. 1 and May 1, 1388", according to which there was laid in the first four months of that remote year 1,310 miles of railway track. It also reported 4,073 miles under construction. This included, however, 550 miles on Canadian lines, and contained such errors as the duplication of one line 150 miles in length and the inclusion of a large number of lines on which the present use of shovel and pick is extremely doubtful. It should be said also that a considerable number of lines were omitted. Whether the omissions or inclusions were largest we cannot undertake to say, until we prepare our summary of the work under survey and construction for the first six months of the year. Our contemporary promises a future supplementary table with a recapitulation by States, and it will in this issue find tolerably correct information to base it on, for, while we cannot undertake to promise that there are no errors or omissions in our list, we think that it is substantially correct.

While the partial cessation of construction during the present year necessarily tends to make it dull times for engineers and contractors, for which we are heartily sorry, yet the situation has its redeeming features. It is certain that such a record as that of last year could not be long kept up without overdoing the matter greatly; for, to tell the truth, we are getting the arable sections of this country pretty well supplied with railway lines. Repairs, renewals, additional tracks and improved terminals on old roads furnish an amount of employment now which will soon exceed that required for extensions. The engineering profession, too, is becoming more and more appreciated by our railway managers in connection with the departments of maintenance of way, water supply, material etc., as well as in the general management, and is no longer entirely a migratory profession. In the long run it will be far better for all concerned that the work of railway extension shall go on without too great rise and fall from year to year, for an excessive activity is sure to be followed by a corresponding dullness. Therefore there is cause to rejoice

rather than regret that there is so little foundation for hasty predictions of another year of heavy construction.

A Question of Dynamics.

A correspondent has lately sent us some sample bullets showing the effect of impact between bullets in motion and at rest, from which we have prepared the accompanying full scale engravings, faithfully representing their appearance and relative weights as they were before and after their collision. In each case the small bullet (22 calibre) was the one in motion, and was fired into the one at rest.

It will be remembered by our constant readers that over a year ago (April 9, 1887) we published an engraving of a head collision between two locomotives, one in motion and one at rest, the one in motion having mounted on the back of the other in very curious fashion. We then pointed out, in that and succeeding issues, that when both locomotives were in motion, in head collisions, they generally reared up into a nearly vertical position with "locked arms", and suggested that the effect was naturally very different between any two bodies in collision whether one or both were in motion, even if the velocity of impact was the same. We then pointed out, what really ought to have been self-evident, that the prevalent custom of talking about "united velocities" in cases of collision was very erroneous, it making all the difference of 2 to 1 in destructive effect whether the "united velocities" was 60+0= 60 miles per hour or 30+30=60 miles per hour. It appears, however, from the letter which we print and comment on below, as well as from several other dissenting communications which we published at the time, that this is not so self-evident as we supposed; and it was also disputed by several persons that it made any difference in the effect which body was in motion.

That this last contention is wrong, and that our own position was right, seems to us to be proved by the bullets of our corespondent, who has tried precisely the experiment we suggested, fired them into each other and preserved the result. Is there anything in these engravings by which one can tell which was the bal in motion? Until some one produces equally good experimental evidence to the contrary we shall deem it self-evident that there is. The little ball *must* have been the one in motion, and the other at rest, from the form of the remnants. Had the contrary been the case, although the velocity of collision might have been the same, the result would have been quite different. The little ball would have been "wiped out", and the larger one gone on practically uninjured. If the theories of those who contend that it makes no difference which body is in motion were correct, there would be no difference in the effect.

The letter of our correspondent, above referred to, was as follows:

"Allow me to offer a criticism on your note regarding the 'Question of Dynamics' in your issue of June 4, 1887.

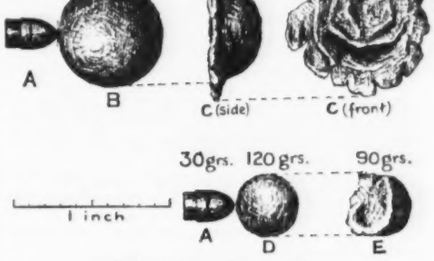
"It is true that the ratio of Mv^2 to $2M\left(\frac{v}{2}\right)^2$ is that of the energies of a single train having a velocity v, and two trains each having the velocity $\frac{v}{2}$, *when the energies are applied to some object at rest on the earth; but it is not true when applied to crushing the trains.*

"The fallacy is in failing to consider motion as relative rather than absolute.

"A body might have a velocity of zero, and therefore no energy as referred to same point on the earth, and yet produce a great many foot-pounds of work by contact with some other planet. In this case the position and velocity of the earth makes no difference. Thus, in our problem of the trains, we have nothing to do with the earth except to state that the velocity of approach of one train to the other is $v + v_1$ or 60 miles per hour, and the energy with which they will collide is not represented by the work they are capable of doing to a bank of earth, $\frac{1}{2}Mv^2 + \frac{1}{2}Mv_1^2$, but $\frac{1}{2}M(v + v_1)^2$, whether the earth moves with reference to only one or both trains." Yours truly,

E. P. DEWEY.

Let us endeavor to point out the error in this reasoning: For all practical purposes, in terrestrial dynamics, we consider the earth as at rest. To do otherwise merely confuses the mind to no purpose. To put any fragment of the earth, like a train, in motion relatively to it, requires the storing in it of a certain imponderable but very definite something called *energy*, the amount of which is a positive thing, like a ton of coal. It is strictly measured by the velocity with which the body is moving, and is as the square of the velocity. Precisely as, and to the same extent that, a ton of coal will drive a certain train a certain distance, a quantum of energy, stored in the form of velocity within the train, will drive it likewise a certain distance, or, in either case, do other equivalent work.



A Question of Dynamics.

[Effect of collision between two bullets, the small one in motion, the large one at rest. Full size. The remnant of the small bullet was clearly inside in the center of the larger one in the first case, but not in the last one which was a somewhat glancing blow.]

Now when two trains come into collision, the usual result, and practically the only one possible or to be considered, is that they do a certain amount of smashing and tearing on each other, and on surrounding objects, until they have used up in other forms of work the energy originally destined to peaceful propulsion, and then both bodies together come to a state of rest, relatively to the earth whose motion seems to cause so much confusion.

This energy is not necessarily that due to the velocity of the body as a whole, in fact, it never is, in a train. There is likewise internal motion leading to the storing of more velocity. The wheels are whirling as well as advancing, and each particle in them is moving in a curved path through space faster than the body as a whole, with a resulting addition of 5 to 12 per cent. to the energy called for by the lineal velocity. By mounting heavy flywheels on each car, driven from the axles, we might make this excess 20, 50, 200 or any other per cent.

But whether it be much or little, if a train moving at 30 miles per hour has energy equal to that generated by the combustion of one ton of coal, let us say, stored in it, a train which is moving with twice that velocity has stored in it the energy corresponding to *four* tons of coal (2^2) and it will not, and cannot, be made to come to rest until it has expended on somebody or something *four* times as much work; in other words, got rid of every last fragment of its energy. Two trains which come together with the same "united" velocity, half of it in each, have say a "ton" of energy in each, or two tons in all, and consequently they will come to rest after doing only two tons' worth of work, instead of the four tons' worth which must be got rid of before the two trains which collide at 60 and 0 miles per hour come to rest.

This ought to be self-evident, and that it is not so comes from confusion of mind as to the nature of energy. It is not a relative thing, in any sense. It is an absolute and definite thing, as much so as a ton of coal. The destruction which comes from collisions does not come from the velocity, and has nothing to do with the velocity. It comes from this definite quantity of energy; and when we have weighed the aggregate energy we have likewise weighed the aggregate of destruction, although not necessarily the precise form that it will take.

PERSONAL.

HOWARD BATCHELDER has been appointed Assistant City Engineer at Albany, N. Y.

H. M. LANE, C. E., Engineer of the Vine St. and Walnut Hills cable railways, at Cincinnati, O., is Consulting Engineer for the Denver Tramway Co., at Denver, Col., which is about to build a cable road.

PAUL F. BABBAGE, of Keene, N. H., has been elected Superintendent of Water-Works.

EDWARD O. GERAN, of Manitowoc, Wis., has been appointed Superintendent of the Water-Works.

D. C. DODGE has resigned his position as Vice-President and Manager of the Mexican National Ry. Co.

W. P. HOMAN, General Manager of the St. Louis, Arkansas & Texas Ry., has been appointed to a similar position on the Missouri, Kansas & Texas Ry.

EDMUND SMITH, First Vice-President of the Pennsylvania R. R. Co., has resigned his position.

C. S. MELLEN has been appointed General Purchasing Agent of the Union Pacific R. R., with office at Omaha, Neb.

HOWARD C. DOLLES, Engineer of the Powell St. cable road, at San Francisco, Cal., will superintend the construction of the Portland Heights cable road at Portland, Ore.

T. MOORE JACKSON has been appointed to the newly established chair of Civil and Mining Engineering, at the West Virginia University, Morguntown, W. Va.

ELI ASSELIN, Bridge Inspector of the Grand Trunk Ry., died recently at Montreal.

W. W. FOLLETT, C. E., formerly of Shreveport, La., but now in charge of drafting office, Dept. of Fuel and Mines, A., T. & S. Fé R. R., Topeka, Kan., was married on the 13th., at Pueblo, Col., to Miss HELEN JORDAN.

PUBLICATIONS RECEIVED.

Statistical Abstract of the United States, 1887. Finance, Coinage, Commerce, Immigration, Shipping, Postal Service, Population, Railroads, Agriculture, etc., Bureau of Statistics, Washington, D. C., pp., 254. Gives very full information on all these heads, running back for a long series of years.

Among the notable illustrations in the railway article on "Engineering Feats", in the June *Scribner's*, will be full-page views of the St. Louis Bridge in process of construction, the Brooklyn Bridge (from a painting by J. H. TWACHTMAN), the Great Loop, near Hagerman tunnel on the Colorado Midland, and the interior of a pneumatic caisson with men at work.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—At the meeting on June 20, Director A. FTELEY in the chair, and a small number of members present, the Secretary announced the Convention arrangements which were published in last week's paper. In addition to the papers already announced there will be presented an interesting one on "The Panama Canal; its Material and Plant", by Mr. WILLIAMS; the paper will be illustrated by a number of photographs.

The Secretary read a paper by Mr. A. D. FOOTE, Mem. Am. Soc. C. E., describing an "Automatic Waste Weir", for preventing the serious effects of freshets in irrigation canals; the gate opening by the pressure of the water when it reaches a certain height at the dam, and closing automatically when the level of the water has been reduced. The gate turns on horizontal pivots, placed about two-thirds below the maximum height of water in the canal: when the level of the water rises the center of pressure is above the pivots and the gate opens, the top turning down stream and resting on a cross piece which arrests it at an angle of about 8° with the horizontal. When the water has fallen the pressure on the lower portion of the gate causes it to rise to

its normal position. Mr. FOOTE suggested that this apparatus could be used as an auxiliary for waste weirs at reservoirs.

Mr. FTELEY described a device of his own, suggested for a dam at Framingham, Mass., in connection with the water supply of Boston, for temporarily lowering the crest of the dam in case of freshets, in order to prevent the flooding of valuable land. The ordinary arrangement of flash boards, which would give way under a certain pressure, could not be adopted, as the sudden rush of such a volume of water would be too much for some bridges below the dam. Mr. FTELEY's device consisted of two parallel rows of vertical pins on the crest of the dam, the up stream row being merely to act as guides and to support the planks when there is no water behind them, and the down-stream row so arranged that the planks overlap by increasing distances; that is the end plank, would project 2 ins. beyond the pin, the next 4 ins., the next 6 ins., etc. Planks, or flash-boards, would be placed in a row between the pins and at the end of the dam would be an hydraulic pump. In case of a freshet the pump would push along the whole row of boards; when the one at the opposite end had been pushed 2 ins. it would be carried away, the next would go at 4 ins., the next at 6 ins and so on, until all the planks were gone, thus gradually reducing the level of the water. The size of the pins would be so calculated that in the event of the failure of the pump, a certain pressure of water would carry them away. The subject was briefly discussed, and Mr. ACKENHEL stated that a similar device to the automatic gate had been used 200 years ago by the Spaniards, for irrigation purposes.

The Secretary referred feelingly to the loss, by drowning, of the daughter and two grandsons of Mr. THOS. C. KEEFER, President of the Society, which was noted in our last week's issue.

New England Water-Works Association.—*Seventh Annual Convention* (*Continued from page 499*)

ACTIVE MEMBERS.

R. C. P. Coggeshall, Supt., New Bedford, Mass.; Wm. R. Billings, Taunton, Mass.; Edwin Darling, Supt., Pawtucket, R. I.; Albert P. Glover, Registrar, West Newton, Mass.; Jno. A. Tilden, Hussey Meter, Co., So. Boston, Mass.; Geo. E. Winslow, Supt., Waltham, Mass.; Edwin F. Pierce, Walworth, Mfg. Co., Boston, Mass.; John C. Chase, Supt., Wilmington, N. C.; Chas. E. Bolling, Supt., Richmond, Va.; Jesse Garrett, Philadelphia, Pa., R. D. Wood & Co.; J. E. Denton, Hoboken, N. J.; J. F. Koezly Hoboken, N. J.; G. E. Granniss, Supt., New Haven, Conn.; F. W. Sheppard, *Fire & Water* N. Y. City.; Wm. Oliphant, Gen. Manager, Oliphant Filter Co., N. Y. City; Harvey Rocske, Gen. Manager, Phila. Water Purifying Co., Phila., Pa.; H. A. Peckham, ENGINEERING NEWS, N. Y. City; W. J. Harris, Edson Recording Gauge, N. Y. City; Thos. J. Macey, N. Y. City; Fred. Adee & Co.; J. Hastings Howland, New Bedford, Mass.; W. H. Marsh, N. Y. City; A. H. Richards, Supt., New London, Conn.; Geo. F. Chase, Supt., Taunton, Mass.; D. B. Kempton, New Bedford, Mass.; Louis H. Knapp, Supt., Buffalo, N. Y.; Stephen E. Babcock, Chief Engr., Little Falls, N. Y.; The Water Waste Prevention Co., N. Y. City; John F. Philbine, Reg., Clinton, Mass.; H. B. Hunship, Norwich, Conn.; Geo. E. Batchelder, Reg. Worcester, Mass.; C. E. Pierce, Supt., Fire Division, East Providence, R. I.; Solon F. Smith, Supt., Grafton Water Co., Mass.; Benj. S. Levey, Exhibitor, Providence, R. I.; G. B. Fitts, Supt. and Reg., Attleboro, Mass.; R. M. Gow., Supt., Medford, Mass; H. Salisbury, Lawrence, Mass.; Chas. K. Walker, Manchester, N. H.; Thos. C. Lorell, Fitchburg, Mass.; Horace G. Holden, Nashua, N. H.; J. G. Tenney, Leominster, Mass.; W. B. Rogerson, Mansfield, Mass.; Chas. H. Swan, C. E., South Boston, Mass.; Jos. A. Lockwood, Yonkers, N. Y.; John C. Kelley, N. Y. City; Chas. H. Baldwin, Boston, Mass.; F. G. Crandall, C. E. Burlington, Vt.; R. S. Cooledge, Bellows Falls, Vt.; A. W. Morgan, Buffalo, N. Y.; Geo. J. Rice, Weymouth, Mass.. H. A Walsh, Jr., Weymouth, Mass.; A. T. Noyes, City Engr., West Newton, Mass.; Wm. B. Sherman, Providence, R. I.; Phineas Ball, Worcester, Mass.; J. E. Beals, Middleboro, Mass.; L. F. Rice, Boston, Mass.; M. N. Whittman, North Attleboro, Mass.; T. H. McKenzie, Southington, Conn.; W. S. M, Hawes, Fall River, Mass.; W. M. Moulton, Worcester, Mass.; F. A. Volk, Ware, Mass.; W. Kent, Woonsocket, Mass.; D. Fitzgerald, Boston, Mass.; F. L. Fuller, Boston, Mass.; C. W. Seymour, Hingham, Mass.; W. H. Harris, Hingham, Mass.; Parker Merrill, Supt., Melrose, Mass.; Hiram Nevost, Cambridge, Mass.; F. E. Hall, Quincy, Mass.; E. H. Phipps, New Haven, Mass.; C. F. Allen Hyde Park, Mass.; B. M. Earle, Providence, R. I.; Geo. A. Stacy, Marlboro, Mass.; Wm. F. Codd, Nantucket, Mass.; H. W. Connuet, Gardner, Mass.; H. N. Hyde, Jr., Newton, Mass.; Ludlow Water Co. Troy, N. Y.

NEW MEMBERS ELECTED.

Resident Active—A. S. Burnham, Supt., Revere, Mass.; H. R. Chase, Supt., Great Falls, N. H.; Thos. N. Drown, Prof. Chem. Mass. Institute of Technology, Boston; Parker Merrill, Supt., Melrose, Mass.; J. Herbert Shedd, C. E., Providence, R. I.; Fred. A. Volk, Supt., Ware, Mass.; Geo. F. Chase, Supt., Burlington, Vt; *Non-Resident Active*—W. B. Cunningham, Supt., Trinidad, Col.; Jas. Davidson, Supt., Central City, Col.; H. M. Newton, Supt., East Saginaw, Mich.; Lewis H. Pengilly, C. E., Tuxedo Park, N. Y.; J. W. Troy, Supt., Pierre, D. T.; Timothy Woodruff, Supt., Bridgton, N. J.; Chas. E. Bolling, Supt., Richmond, Va.; Heland C. Hitchcock, Treasurer, Addison, Steuben Co., N. Y.

ASSOCIATE.

Fred. Adee & Co., N. Y. City; H. R. Buskee, Lowell, Mass; H. M. Brewster, Manager Stebbins Mfg. Co., Springfield, Mass.; James B. Edson, New York; Jackson & Woodin Mfg. Co., Berwick, Pa.; B. S. Tevey, Providence, R. I.; Water Waste Preventive Co., N. Y.; George Ross, Troy, N. Y.; Wm. Oliphant. N. Y.

LIST OF EXHIBITORS.

The Oliphant Filter Co., N. Y. City, Represented by W. Oliphant; Fred Adee & Co., N. Y.; Chapman Valve Co., Indian Orchard, Mass.; Walworth Mfg. Co., Water Works Supplies, Boston, Mass. By E. F. Pierce; Union Water Meter Co., Worcester, Mass.; Jarvis B. Davis, Recording Gauge, N. Y. City; A. W. Harris Oil Co., Providence, R. I.; Philadelphia Water Purifying Co., Philadelphia, Pa.; Ross Valve Co., Troy, N. Y.; Jenks Drinking Fountain; Tuerk's Hydraulic Power Co., N. Y. City, by G. Ross. Troy, N. Y.; Winslow Reservoir Gauge, by Geo. E. Winslow, Waltham Water-Works; Morgan's Extension Shut-Off Boxes, Boston, Mass.

THURSDAY, JUNE 14.

The morning session was called to order by President DARLING and the subject, the best method of locating gates and specials, was taken up for discussion.

Mr. TIDD of Boston said:

"In building a new works there are many cases where water pipe crosses streets in which no pipe is to be laid at present, but we must always make provision for future extensions, and in such cases I always place a branch on the main line and plug it, to be used at such time as the extension is to be made. These branches we tie in by cross measurements from 2, 3, 4 or 5 different points.

With gates I have always taken great pains to place them on the line of the streets, and have even been so particular in this respect as to cut pipe in order to make them come there. I find it is a very easy matter to find them by measuring along the line, and by keeping careful record of all measurements in a carefully indexed book, which the superintendent can carry in his pocket, which has in detail all the connections of the works. In the earlier days we did not use many gates, they were thought to be too expensive, and looked upon as a luxury, but necessity has forced them upon us. In the works which I am building I use more and more gates. One half or two-thirds of the gates are never used: but when we want to use one, it is worth much more than its cost and the cost of placing it on the line of pipe.

Mr. ALLEN: We have invented a way in Hyde Park for locating gates by means of a bolt with a round head, which we place on the fence or any other convenient location at a distance of 10 ft., 15 ft., or any multiple of 5 ft. from the box to be located.

Mr. DARLING: I find that there is a lack in building water-works of not putting in gates enough. I find in my experience, in the position I hold at Pawtucket, that originally they did not put in gates enough. We have trouble in certain sections of the city, especially in the original 26 miles that was laid. A gate wanted at a certain time is worth much more to us than its cost. We locate our gates on the street line, and keep a record of them in a book. The foreman of the pipe department can take his tape line and locate a gate very quickly.

The President appointed as a Committee to report on the joints of pipe and their relation to special castings etc. Messrs. DESMOND FITZGERALD, CHAS. H. SWAN and ALBERT F. NOYES.

Mr. STEPHEN E. BABCOCK, Chief Engineer, Little Falls N. Y. Water-Works, then read a paper on "The Aeration of Water Supplies by Natural Canals and Low Dams."

The principal portion of this paper was devoted to statements in regard to the influence of aeration on the purity of water, and various authorities were quoted by the author to prove that the most effectual remedy for impure water is its aeration by "a violent mixing with common air." The author then described his practical application of this idea to the works which he is now building at Little Falls. The water supply is from an exceptionally pure mountain brook and is brought through a closed conduit a distance of 8¾ miles. For a distance of 2,500 ft. before entering the distribution reservoir an open paved channel was constructed on which are 16 weirs 10 ft. long and 2 ft. high distributed along the open channel at intervals of 50 to 100 ft. The supply pipe to the distribution reservoir empties by an overfall of 2 ft. at the center. The open channel in which the water flows also forms a series of subsiding pools or reservoirs and when desired the sediment which deposits in these can be washed out and diverted through a gate into a by-wash canal. To finally ensure the purity of the water a coke filter is provided at the inlet chamber of the distribution system. Provision is made for cleaning the filter whenever wished.

In answer to questions, Mr. BABCOCK stated that the aerating canal effected a perceptible improvement in the color of the water when it became colored during the season of heavy rains. The change in the temperature while passing through to the aerating channel was 4 to 5 degrees. The total cost of the aerating channel, filter, etc., was $15,000.

A paper was then read by W. C. BOYCE of Worcester, Mass., entitled, "Can Tests by Tubular Wells be Relied upon to Show the Amount of Water That May be Obtained for a Public Water Supply."

Following this the election of new members took place, the gentlemen named above being elected to Membership.

A paper was read by CHAS. H. SWAN, C. E., of Boston, Mass., on Covered Reservoirs", following which the election of officers took place. The following were elected:

HIRAM NEVINS, CAMBRIDGE, Mass., President; DEXTER BRACKETT, V. C. HASTINGS, S. S. COOLIDGE, GEO. P. WESTCOTT, CHAS. E. CHANDLER, Vice-Presidents; R. C.P. COGGESHALL, Secretary; ALBERT S. SLOAN, Treasurer; Prof. GEO. F. SWAIN, Senior Editor; W. H. RICHARDS, Junior Editor; FRANK E. HALL, W. R. BILLINGS, E. R. DARLING, Executive Committee; GEO. E. BATCHELDER, JNO. H. HATHAWAY, Finance Committee.

No session was held in the afternoon, a trip being taken by the members to the Mt. Hope reservoir.

At the evening session the first paper read was by Mr. S. E. BABCOCK on "The Use of Relief or Safety Valves in Water-Works Distribution Systems". The author was led to the use of relief valves by the problems presented by the distribution system of Little Falls, N. Y., where the lowest point of the district served was 540 ft. below the only site available for a reservoir, and the author said:

"I at once saw that I must use pressure valves to reduce pressure in the distribution system, which I determined to place at the 250 ft. head point, and to cut out 200 ft., leaving me 50 ft. at this point, or 340 ft. head on the main portion of the system. But experience has taught me, that sometimes the full pressure gets on the system in spite of you, and that sometimes, occurs too disagreeably often to make it at all desirable, or safe, to calculate the weight of pipe on the reduced head.

"In determining upon the most desirable formulas upon which to base the standard weights of pipe I found, first, that all the manufacturers' tables of weights stopped at about 300 ft. head. A comparison of the weights used in the various water-works of the country, or at least such as I could obtain access to, showed that about 300 ft. was ordinarily the limit of head of the various systems, and it also showed a multiplicity of standards, the very same state of facts, to which Mr. NOYES' paper, in 1885, calls attention.

"The formulas, as given by various authors, embrace such a wide latitude of co-efficient of safety, that they almost cease to be any guide, particularly on the smaller sizes of pipe.

"This set me thinking. I knew what the theoretic strength should be, taking iron at its strength as generally used, viz., 16,000 lbs. to the sq. in. I have learned by experience of the imperfections of castings, cold shuts, unequal thicknesses, brittleness from chilling and the many other defects, the provisions that must be made for careless handling, and lastly the most serious difficulty, the bugbear of all water-works, the water ram, that more than stares you in the face. That there is a certain weight or amount of metal that must be used, known as the least weight that metal will run at without chilling in the mould when running, is also another factor. I also understand that it costs no more to mould and run a heavy casting than a light one, except the bare cost of the metal used, and that the metal itself is only a factor of about one third that enters into the cost of cast-iron pipe, ready for delivery. I can readily see that the result is that pipe founders desire as heavy weights as possible, and want an extra price for light pipe, and that it is to their interest to decry all attempts to lighten weights."

After a discussion of the theory of water ram, the author states that he finally decided to allow one safety valve of 3 in. area to each mile of pipe in the system, and one at each dead end, to be located at summit points and especially thick in the manufacturing districts.

"I then settled in my mind what seemed to me a tangible basis upon which to formulate the weight of pipe for the system, which was, to calculate the standard weights of pipe on the basis of one-tenth the tensile strength of cast-iron, of 16,000 lbs. to the sq in., for the various heads, subdividing the system into three classes of pipe: *A*, 250 to 350 ft.; *B*, 350 to 425 ft.; *C*, 425 to 540 ft.; for all pipe larger than 6 in.; and use two classes for 6 in. and 4 in. pipe, viz.; *A*, 250 to 375 ft.; *B*, 375 to 540 ft.; and on the large feed mains and conduit, two classes: *A*, 0 to 150 ft.; *B*, 150 to 250 ft., making the use of one 3 in. safety valve to every mile of pipe and at the dead ends an adjunct or factor of safety."

"My reason for preference in using one-tenth the tensile strength was this: my experience in connection with iron casting has taught me that, on the lighter weights as called for by the calculation, the thickness ran down too close to the limit at which iron will run well, to use any factor of safety less than one-tenth. The element of transportation or careless handling cracks also inclined me to keep the safety factor up to one-tenth instead of one-fifth. A comparison of my weights with the manufacturers' tables, also with the weights used in very many of the large cities, showed that at one-tenth I was under either of them, except perhaps a place here and there."

"In determining on the type of safety valves, I concluded to adopt the ordinary valve held down by a spiral spring, such as are generally used to relieve water pressure on railroad water columns. The more expensive pop safety valves are more certain perhaps to respond to small changes of pressure, but are much more expensive and under certain conditions that may arise, more desirable. However, at Little Falls I adopted the common railroad valve. The cost was as follows:

Twenty 3 in. safety valves, @ $12.50	$250.00
Cost of setting, @ $10.00	200.00
Total cost	$450.00

The application or use of safety valves in a distribution system is not patented, and I am advised by patent lawyers that it is not patentable; it is therefore free to all."

The total weight of the mains proportioned in this way was 2,663 tons, which cost at contract prices $84,476. The weight by manufacturers' lists, using their lists up to 400 ft. head, and proportioning balance at same ratio would have been 3,211 tons, costing, at the same contract prices, $101,655. The difference in cost or saving was $17,179.

The actual results at Little Falls have been very satisfactory, and a severe test to which the system was subjected showed that the safety valves were perfectly competent to protect the system from any water ram that could possibly occur.

The concluding paper was by L. FRED RICE on the Boston Water Meter Tests.

It was voted to hold the next Meeting at Fall River, Mass., and the final adjournment was taken.

Master Car Builders' Association. The 22d Annual Convention at Alexandria Bay opened on June 12 with about 75 members present only. The hall was on an island some distance from the hotel and accessible only by steamer. Pres. WM. MCWOOD presided. Secretary FORNEY reported that the membership was now 135 active, 90 representative, and 2 associate, 227 in all, a net loss of 3. The number of cars represented was 580,054 in 1886, 689,555 in 1887, and over 700,000 now.

After various formal proceedings the Committee on Standards and Appliances for the Safety of Trainmen (M. N. FORNEY and JOHN KIRBY) submitted the following recommendations, preceded by a summary of the responses to their circular.

The causes of falling from cars, as indicated by the answers to the Committees' circular, may be summed up as follows:

1. Train slack.
2. Cars too far apart.
3. Diversity of construction of cars.
4. Inadequate inspection.
5. Defective and wrongly located ladders, steps and hand-holds.
6. Foot-boards too narrow or defective.
7. Defective brake apparatus.
8. Inadequate means of getting over coal cars or from one car to another.
9. Too much slope to car roofs.

The remedies proposed are:

1. Close couplings.
2. Automatic brakes.
3. Less distance between cars.
4. Wider running-boards.
5. Better and more substantial ladders, hand-holds and steps, securely fastened and constructed to a uniform standard.
6. Uniformity in height of cars.
7. Railing on edge of roof of cars.
8. Steps on pilots of engines.
9. Improved brake appliances.
10. More thorough inspection of the brakes and appliances for getting on or off cars.

As the efforts of this Association to secure the adoption and use of close couplings and automatic brakes, are being exerted through other instrumentalities, your committee do not feel called upon to say more than that they feel satisfied that their use would lessen materially the number of accidents to train men, not only from falling from cars and engines but from other causes.

With reference to the distance between cars they recommend that the running boards of box-cars be made to project over the ends of cars so that the minimum distance between the ends of the running boards will not be over 12 ins., and that the running boards be made not less than 2 ft. wide and made of 3 boards 7 × 1 in. The projecting ends of running boards to be supported on 2 brackets at each end of car made of ⅜ × 1¾-in. iron with a hard wood cleat 3 × 1 on upper ends fastened with ½-in. bolt and nut in each bracket. The lower end of each bracket to be fastened to end of car with two ½-in. bolts and nuts.

After considerable discussion as to the best form of hand-hold the recommendations were referred to letter ballot.

With reference to ladders the Committee see no good reason for changing from the present standard of the association excepting to make the specifications for the construction thereof more explicit, as follows: That each box and stock car have two ladders, one attached to each end of the car next to the corner which is on the left hand side when a person is facing the end of the car. That the sides of the ladder be made of two pieces of hard wood 3½ ins. wide by 2 ins. thick, each piece to be fastened with four ½-in. bolts and nuts to the end of the car, the narrow sides being against the car. The distance between the strips to be 15 ins. Each ladder to have not less than five steps or rounds made of ⅝ in. round iron; each step to be fastened to the ladder sides with one ½-in. bolt in each end. The lower round to have a guard or protection, to prevent men from slipping when swinging around the end of the car to get on the step. A hand-hold to be attached to the top of the car roof parallel with the ladder rounds, 15 ins. from the end of the roof. The hand-hold to be made of ⅝-in. round iron not less than 17 ins. long, center to center of bolt holes, and to be fastened to the car with 2½-in. lag screws. Two good substantial steps, made of wrought-iron ½ × 1¾ ins. sections, to be fastened, one to each side sill, at the corner of the car to which the ladder is attached. The steps to be not less than 12 ins. long measured horizontally between the sides, and the tread to be not less than 8 ins. below the bottom of the sill. The side of the step nearest the corner of the car to be as near to the corner as practicable. Each side of the steps to be fastened to the sill with two ½-in. bolts and nuts. A hand-hold to be attached to the side of the car above each step to be placed horizontally 2 ft. above the bottom of the sills. The hand-hold to be made of ⅝-in. round iron, 2 ft. long in the clear between the ends, to have 2½ ins. clear space between it and the sides of the car. To be fastened with an ½-in. lag screw in each end, screwed not less than 2 ins. into the framing. Another handle of the same size to be fastened horizontally to the end of the car, the same distance above the sills, and on the opposite side from the ladder. The brake shaft to be placed on what is the left-hand corner of the car, when a person is standing on the track facing the end of the car. The ratchet wheel and brake pawl to be fastened to a suitable casting attached to the roof. A railing or guard to be attached to the end of the roof of the car around the brake shaft. The center of the brake shaft to be 20 ins. from the middle of the car. Much complaint has been made of the present insecure and unmechanical method of fastening brake wheels to their shafts and some better way of doing it is needed. The Committee are not prepared to recommend any other method, excepting that in common use, that is, by a square end on the shaft and a hole of the same form in the wheel with a nut to hold it on. They do recommend though that nuts be secured by a split spring cotter above them.

With reference to the height of the roofs of cars the Committee doubt whether at the present time it would be advisable to make any recommendations. The suggestion of the railroad commissioners of the State of New York, that a railing be placed along the edges of the roofs of cars, should also be considered and discussed by the Association. The Committee hesitate about recommending the use of such railings, because it is said by the Massachusetts commissioners that accidents from falling from the sides of cars are very rare, and because it is undoubtedly true that many accidents are due to very obvious defects which should be remedied at once. The Committee are not prepared to agree with what appears to be the inference of the Massachusetts commission, that because no one appeared before them to advocate any legislation on the subject, that therefore there is no demand for such protection, for the reason that those who need it the most have not the time, ability, or intrepidity to appear before a commission of this kind to advocate their own cause.

The Committee suggests that the matter of steps on the pilots of engines be referred to the Master Mechanics' Association for the consideration and action of that body, with the recommendation that that Association take some action to establish a standard for pilot steps which will diminish the danger complained of.

REPORT OF COMMITTEE ON CAR HEATING.

While it was the endeavor and intention to report upon all the improved methods of heating cars, the interest and attention which is now being given to what may be called continuous heating, in an attempt by the railroad companies to comply with public sentiment and the legislative action in some states, seems to have engrossed the general attention, and has been the subject of all the information that we are able to present.

From the best information at the hands of your committee there has been legislation on the question of car stoves in three states.

In Massachusetts a law was passed in 1887, which is brief in its terms, and as follows:

"No passenger, mail or baggage car on any railroad in this Commonwealth shall be heated by any method of heating or by any furnace or heater unless such method or the use of such furnace or heater shall first have been approved in writing by the board of railroad commissioners, provided, however, that in no event shall a common stove be allowed in any such car; and provided also, that any corporation may, with the permission of such board, make such experiments in heating their passenger cars as said board may deem proper."

"Any railroad corporation violating any of the provisions of the preceding section shall forfeit a sum not exceeding $500.

"This act shall take effect upon its passage."

In New York a law was passed by the legislature in 1887, which reads as follows:

"It shall not be lawful for any steam railroad doing business in this state, after the first of May, 1888, to heat its passenger cars on other than mixed trains by any stove or furnace kept inside the car or suspended therefrom except it may be lawful in case of accident or other emergency to temporarily use such stove or furnace with necessary fuel. Provided that in cars which have been equipped with apparatus to heat by steam, hot water or hot air from the locomotive, or from a special car, the present stove may be retained, to be used only when the car is standing still. And provided, also, that this act shall not apply to railroads less than 50 miles in length, nor to the use of stoves of a pattern and kind to be approved by the railroad commissioners for cooking purposes in dining-room cars."

Under this law the companies had until this spring to make the required alterations.

In Michigan, also in 1887, the legislature passed a law by which it is provided:

"That on and after the first day of November, 1888, every railroad company owning or operating any railroad wholly or partially in this State shall make some effective provision against the burning of cars, in which passengers are carried, in some one of the following or equally effective methods:

"By having the heat for warming the cars outside the car, or by inclosing the heat in a closet or room made of boiler iron or some other material which will afford equal protection against the car taking fire, and by some device by which the fires will be effectually and quickly extinguished, in case the car is overturned."

Some legislative action has been taken in Maine, but your committee failed to get a positive statement of the law.

The subject has also been before the legislatures in Connecticut, Ohio and Illinois, and the railroad commission of Iowa have recommended some legislation on this point, but no final action had been taken in any of these States.

In an endeavor to comply with the laws, as well as to conform to the pressure of public feeling in the matter and to ascertain its real desirability, a number of railroad companies have, from the tenor of their reports engaged in a series of costly and difficult experiments and have been persistently pursuing them in an attempt to solve a problem which is accompanied with more than usual difficulties in its details. A general result is shown in the tabulated statement appended to this report. The substance of this statement will appear in our next issue.—Ed.]

It is only fair to the different systems represented in this statement to say that these inquiries were made during the past winter, and that since that time many important changes in the details have been made with marked improvement. The committee regret that these changes were made so late in the season that they are unable to give you definite information regarding them, but call your attention to the last column of the statement as giving the views of the different railroad companies at the close of the past winter.

The most prominent features of continuous heating common to all systems are the couplers and pressure of steam to be used. The first has been very generally discussed by the railway clubs of the country, and an effort made by a committee representing the leading trunk lines of the east, to arrive at some standard practice in this respect, an endeavor which is much to be commended. From the fact that many systems prefer the metallic connection, and the return systems require a double connection and an additional train pipe, the adoption of such a standard is likely to be only reached by a compromise, if at all.

In regard to the steam pressure, your committee believe that there can be but one opinion in this matter, that it should be kept as low as possible, that the rupture of a highly charged steam pipe in a car filled with passengers would prove quite as disastrous as the so-called "deadly car stove," and the effect of high pressure steam escaping from the trains and rear of train pipes has been commented on as very objectionable in its effect on the paint and varnish of the cars, as well as from condensation about stations.

A point upon which the committee laid some stress, was in regard to the means provided for retaining heat in the car after the locomotive or source of heat was disconnected. This still appears to be an open question. All materials which are slow in giving up their heat, either from bulk or physical properties, are correspondingly long in attaining the desired temperature, so that to obtain one involves a sacrifice of the other. The retention of the stoves within the cars, the use of hot water circulation, or a drum filled with brine, within the steam pipe, seem to have been the most general ways of accomplishing this end.

With appliances such as seem necessary to use for successful continuous heating it is fair to expect occasional failures of the apparatus, disabling it to such an extent as to prevent its use. To best provide for such emergencies is still one of the unsolved problems.

Upon a subject so important, about which there are so many differences of opinion, as well as apparent differences of result, your committee are unprepared to make any definite recommendations, and while regretting their inability to give you more information on a subject of such general importance beg leave to suggest that it be continued for investigation throughout the coming year. Respectfully,

FRANK L. SHEPPARD,
R. D. WADE,
ROBERT MILLER,
} Committee.

Discussion was postponed.

REPORT OF COMMITTEE ON JOURNAL LUBRICATION AND THE BEST PRACTICE FOR ECONOMIZING OIL.

If the replies received from our circular of inquiry can be taken as a fair indication of the practice throughout the country, it is safe to say that pure petroleum, or some product of distillation of petroleum, is the basis for almost all oil used for journal lubrication on our railways, and that such oil is used without any further admixture with other oils on nearly one half of the rolling stock, while Galena oil is also used on nearly one-half of the rolling stock and that a small minority only of our car journals are lubricated with compounds of petroleum and other oils or with grease.

After discussing the reasons for this choice at some length the Committee continues:

We do not regard the solid wooden dust guards or the solid vulcanized dust-guards as at all satisfactory; there are, however, a number of elastic dust-guards which have been brought forward in the past few years, some of which are worthy of attention and would doubtless repay the railroads for using them, especially where they can be made to go into the dust-guard seat of the Master Car Builder's standard boxes.

An examination of the roadbed of any piece of railroad over which a large traffic passes, will convince any one that a large portion of the oil used for lubrication is lost upon the track, and we do not think it extravagant to say that the major part of all the oil used in journal boxes is soon lost on the roadbed and wheels.

Car inspectors and oilers are so closely watched to locate responsibility for boxes which run hot that they are obliged in many cases, for self protection, to pour oil into boxes which will not retain it, all due to bad construction.

It has been popular of late years to allude to the American system of packing journal boxes as very crude and unsatisfactory, and many attempts have been made to introduce mechanical oilers, which would raise the oil from the bottom of journal boxes to the journals as needed; many of these are laudable attempts to improve journal lubrication, but your Committee are of the opinion that none of these methods which they have seen are destined to be superior to packing of good long woolen waste or similar packing in a tight journal box. The mechanical oiler requires a tighter box than the packing does, in order to prevent a greater waste of oil, from the nature of the case; the packing acts as an absorbent to keep the oil in the box to a certain extent while the mechanical oiler operates to throw the oil to all parts of the box, so that it will eventually disappear if there is any opening through which it can escape.

The method of lubrication which has been popular in England, and on the Continent, for a number of years, namely, the use of grease in the upper portion of the box which would melt by the heat occasioned by friction and then would run by gravity to the journal, lubricating its parts, is perhaps a good method of lubrication where petroleum cannot be had cheaply, but such a method of lubrication requires much more frequent attention to bearings than freight cars are apt to receive on account of the passages for lubrication becoming stopped up, either from the wear of the journal and bearing, or from some foreign particles in the lubricant.

After reviewing the whole subject, your Committee is of the opinion that no greater economy can be had in journal lubrication than by the use of petroleum or its products, either with or without admixtures of other oils or lubricants, along with a good elastic or spongy packing of woolen waste or material equally as good and used in a thoroughly tight and well constructed journal box, made especially with a view to preventing the loss of lubricant and excluding foreign particles of dust from journal box.

JNO. W. CLOUD, H. ROBERTS, J. N. LAUDER, } Committee.

The report on ' How Uniformity of the Interchangeable Parts of Cars can be Brought About", was then rea ', which contained little of interest, being a summary of the views of 17 roads, the purport of which was "by making an effort".

CONSTRUCTION NEWS.

RAILROADS.

East of Chicago.

Existing Roads.

Ohio & Northwestern.—This Ohio company has gone into insolvency and SAMUEL HUNT has been appointed receiver.

Port Jervis, Monticello & New York.—The Greenwood Lake & Port Jervis Railroad Company has been incorporated by HENRY R. LOW of Middletown, N. Y. and others to build a railroad from Port Jervis, the southern terminus of the P. J., M. & N. Y. R. R., to the terminus of the New York & Greenwood Lake division of the Erie railway.

Dexter & Newport.—Ground is to be broken next month on this Maine road.

Sinnemahoning Valley.—WM. E. TENCH has the contract for building 25 miles of the extensions of this Pennsylvania road. J. A. SKELTON is General Superintendent. The general offices are at Buffalo, N. Y.

Pennsylvania.—The Philadelphia *Times* of June 19 says: "For some time past HENRY M. HOUSTON has been quietly buying up farms in a direct line from Bryn Mawr to Chestnut Hill and Holmesburg. Mr. HOUSTON is a Director in the Pennsylvania Railroad Company. He has practically secured a belt of country from Bryn Mawr to Holmesburg from a quarter of a mile to a mile in width. Through this belt a railroad is to be constructed, running in a straight line from Bryn Mawr to Chestnut Hill and thence to the New York Division at Holmesburg. The work of surveying has already begun, and the new road will be constructed by an independent company, but will be operated by the Pennsylvania Railroad Company, the same as is the Pennsylvania Schuylkill Valley Railroad.

Midland Ry. of Indiana.—Locating surveys are in progress on the extension from Rockville to Waveland, Ind., and contracts are to be let at once.

South Pennsylvania.—A dispatch from Chambersburg, Pa., to the Pittsburg Commercial Gazette says: "The Chambersburg Board of Trade last night took favorable action upon a proposition to lay before the projectors of the South Penn railroad in Pittsburg a plan to change the route of the road so as to include Chambersburg. The scheme is to induce the South Penn people to use the Harrisburg, Potomac & Baltimore, and Cumberland Valley railroads, already built and in operation between here and Harrisburg, and thus not be under the necessity and expense of building the fifty miles through the Cumberland Valley."

"The plan also includes the using of a part of the old Pittsburg & Atlantic line from here through Cowans Gap, thus avoiding the Roxburg and Kittanning tunnel. The charter of the Pitsburg & Atlantic is owned by the South Penn, and it is argued that the saving by not building an independent line through the Cumberland valley would much more than offset the loss of the money already expended on the tunnel."

Wilkesbarre & Scranton.—A correspondent favors us with particulars of the construction of this short but expensive line recently completed at Scranton, Pa The line extends from Lackawanna Ave., in the city of Scranton to a connection with the D. & H. C. Co.'s R. R. near Minooka, 3.9 miles. The line was built for a double track and required a large amount of masonry and considerable bridging, for its length. About 820,000 lbs. of bridge iron was used in all. The contractors were: Bridges, Cofrode & Saylor; Grading and masonry Brodhead & Hickey; Depot Buildings, John Benore & Sons; Interlocking Signals, Allentown Rolling Mills.

Lehigh Coal & Navigation Co.—Engineer E. S. WHITNEY has finished the preliminary surveys and location for a line from Phillipsburg to Belvidere, N. J., a distance of 12¼ miles.

New Projects and Surveys.

Brookfield.—This company has been incorporated in New York to build a railroad from North Brookfield to Brookfield, a distance of 6 miles.

Boston & Quebec Air Line.—This company is to be incorporated in the Province of Quebec to build a railway from Cookshire, the terminus of the Hereford Ry., now under construction, to a point on the St. Lawrence, opposite Quebec. FRANK JONES, of Portsmouth, N. H., is interested. The enterprise is in the Boston & Maine interest.

Kinzua Creek & Kane.—Incorporated in Pennsylvania to build a railroad from Kane to Nelyville, McKean Co., a distance of 12 miles.

Manchester & Portland.—The Manchester, Conn., Business Men's Association has voted to have the route of this proposed line surveyed at once. Mr. N. T. PULSIFER, of Manchester, is interested.

Elkhart & Western.—H. E. BUCKLEN, of Chicago, has been elected President of this Indiana company, and C. H. WINCHESTER, of Elkhart, Treasurer.

South Norfolk.—The first sod of this Canadian road is to be turned on July 2. The line is to run from Port Rowan to Simcoe, 17 miles.

SOUTHERN

Existing Roads.

Nashville & Knoxville.—Tracklaying has been completed from Lebanon to Gordonsville on this Tennesee road and trains will be running to Carthage by July 4.

Oxford & Durham.—Tracklayers are at work on this road from both ends and it is expected that the work will be completed by the middle of July.

Central Railroad of Georgia.—On the Eufaula & East Alabama extension, grading is completed from Clayton to Ozark, Ala, a distance of 40 miles, and about 20 miles of track have been laid.

Nashville, Chattanooga & St. Louis.—It is rumored that the managers contemplate the construction of a branch from Tullahoma, Tenn., to Lynchburg, about 10 miles.

Roanoke & Southern.—This Virginia company is just closing a contract with the Roanoke & Southern Construction Co. for building its line.

Kansas City, Memphis & Birmingham.—The company has made a proposition to the city of Columbus, Miss., in reference to the proposed extension to that point from Aberdeen, mentioned two weeks ago.

Georgia, Southern & Florida.—Grading is completed to Valdosta, 168 miles from Macon, with the exception of a short gap of ten miles. The tracklaying has reached a point 45 miles from Macon and is in progress at the rate of a mile a day.

Ohio Valley.—At a recent meeting of the directors it was voted to extend the road to Evansville, Ind., and south from Princeton, Ky., as soon as possible.

Louisville Southern.—The final locating survey on the line from Lawrenceburg to Lexington is nearly completed and grading is to begin at once.

St. Augustine & Sea Coast.—This Florida road is being rapidly graded and is to run to Dayton, New Smyrna and Titusville.

Louisville & Nashville.—Tracklaying is in progress on the Huntsville extension of the Birmingham Mineral Railroad.

New Projects and Surveys.

Atlantic, Atlanta & Great Western.—Surveys are in progress on this Georgia road under Chief Engineer W. H. PEYOR, President GEO. T. FRY is marketing the bonds to raise funds, and if successful expects to let contracts in a short time.

Leesburg & Lake Region.—This company has been organized in Florida to build a railroad from Leesburg around Lake Griffin and from Lake Harris to Sumterville, Sumter Co., and to Astatula and Lake Apopka. M. E. BARNETT, of Leesburg is President; and C. S. NOBLE, Chief Engineer.

Decatur, Chesapeake & New Orleans.—A dispatch from Shelbyville, Tenn., to the Nashville *American* says:

"Dr. C. SANDUSKY, President; W. A. FROST, Secretary; A. A. MCCORKLE, General Manager, all of this city, and Col. J. H. HOLMAN, director, of Fayetteville, leave this afternoon for New York City, to confer with the moneyed magnates of Wall Street and adjust all the minor details of the Decatur, Chesapeake & New Orleans Railroad. The outlook for this road is now brighter than at any time since the inception of the project. The trip of our local railroad men simply means that the arrangements and plans are all complete save minor details, which will require conferences with the New York parties to finally settle."

Birmingham & Vernon Mineral.—Incorporated in Alabama to build a railway from Vernon to the Kansas City, Memphis & Birmingham Railroad, a distance of 10 miles.

THE NORTHWEST.

Existing Roads.

Nebraska.—The report of the State Board of Equalization, which assesses the railways of the State for taxation, shows a total mileage of 4,902 miles. The assessed valuation varies from $3,000 to $12,000 per mile, and the total valuation is $28,574,431.

Wisconsin Central.—This company has filed with the Wisconsin Secretary of State notice of intention to extend its line into Ashland and from Marshfield to a point on the Wisconsin & Minnesota R. R., in Chippewa county, a distance of 65 miles.

Manitoba & Northwestern.—P. D. Mann, of Winnipeg, has the contract for the extension from Langenburgh to Sterling, about 25 miles. It is thought that the company will soon begin work on an extension from Portage la Prairie to Winnipeg.

New Projects and Surveys.

St. Paul, Black Hills & Pacific.—It is stated that a preliminary survey is to be made for this proposed line to run from Dickinson or Mandan on the Northern Pacific, to the Black Hills. L. G. JOHNSON of Aberdeen is General Manager.

Pawnee.—This company has been incorporated in Illinois to build a railway from Taylorville, to a point on the St. Louis & Chicago Railroad midway between Glenarm and Divernon, Sangamon Co. The incorporators include CHAS. KERR, JOHN F. ARMSTRONG and COLUMBUS WHITE of Springfield, and C. E. CLAYTON of Pawnee.

Sioux City & Northern.—Surveyors are at work on this line between Slayton, Minn., and Luverne.

St. Paul, Minneapolis & Manitoba.—Work is in progress on the piers for the bridge near Granite falls, Minn., on the Willmar & Sioux Falls extension. Tracklaying on this line has begun, and is also in progress on the Eastern Ry. of Minnesota, the extension of the Manitoba system to Lake Superior.

Minneapolis, St. Paul, & Sault Ste. Marie.—The instrument consolidating the Minneapolis, Sault Ste. Marie & Atlantic, the Minneapolis & Pacific and the Aberdeen, Bismarck & Northwestern companies has been filed in Minnesota. The capital stock of the consolidated companies is $21,000,000.

THE SOUTHWEST.

Existing Roads.

Texas & Pacific.—A survey is in progress for a branch road from Plaquemine, La., down the bayou 9 miles to reach deep water and connect with a steamer line.

Mississippi River & Bonne Terre.—Track has been laid on this Missouri road for a distance of about 2 miles from Bonne Terre. J. H. SERVISS of Bonne Terre is Chief Engineer.

Kansas City & Pacific.—On the extension from Selma toward Paola, Kan., about 4 miles of track have been laid,

Marshall, Paris & Northwesten.—Grading is well advanced on this Texas road from Paris toward Marshall for a distance of 30 miles, and from Marshall toward Paris a distance of 15 miles and work is to be pushed rapidly forward.

San Antonio & Aransas Pass.—This company has absorbed the Waco & Brazos Valley enterprise, which had secured some local aid and made some surveys for a line of railway from Waco south to Cameron Tex.

Missouri Pacific.—The Jefferson City, Boonville & Lexington branch has been completed to Boonville, Mo., making 50 miles of track laid since the beginning of the year. Surveys are reported in progress between Lamar and Springfield, Mo.

St. Louis, Kansas City & Colorado.—A press dispatch from Ft. Scott, Kan., states that the directors of this company have voted to ratify the issuance of a deed of trust to the Santa Fé company to the amount of $25,000 per mile, the proceeds to be applied to the payment of the existing line and the construction of the road.

St. Louis, Arkansas & Texas.—A line is projected by this company from Arthur City, Tex., on the Red river *via* Mt. Pleasant and Jefferson to Shreveport, La. Agents are working up local aid and rights of way.

New Projects and Surveys.

New Orleans Belt.—The managers of the railway lines terminating at New Orleans recently held a meeting with the city council to consider the matter of a proposed belt line for freight transfers. There was a unanimous expression in favor of the project.

Kansas City, Arkansas & New Orleans.—The survey of the division between Pine Bluff and Monticello has just been completed. GEO. W. WILLIAMS of Little Rock is locating engineer.

Houston, Central Arkansas & Northern.—Grading is to begin at once on the division between Monroe and Bastrop, La. W. A. BRIGHT is Chief Engineer with headquarters at Monroe, La.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Mexican Central.—General Manager EDWARD JACKSON informs us that the mileage laid on the Guadalajara branch prior to Jan. 1, 1888, was 66 miles, instead of 61, as given in our last week's summary. The remainder of the branch, 101 miles, was laid between Jan. 1, and April 30 of the present year. Grading is now in progress between Aguascalientes and Salinas, 62 miles, and surveys are being made from Salinas to San Luis Potosi, 64 miles.

Oregon Ry. & Nav. Co.—At the annual meeting at Portland, Ore., June 18, the old board of directors were re-elected, and the policy of building the extensions on which work has recently begun was confirmed.

Seattle, Lake Shore & Eastern.—Eighteen carloads of steel rails were shipped to this Washington Territory company on June 16, from the steel works at Pueblo, Col. These are said to be the first steel rails ever shipped to the Pacific Coast from a manufactory

west of the Missouri river. Other shipments are soon to follow.

Union Pacific.—The Union Pacific, Lincoln & Colorado Ry. has been incorporated in Colorado by officers of this company to build a railroad from the Kansas State line to Denver with various branches to Colorado Springs, Canon City and the southern part of the State.

St. Paul, Minneapolis & Manitoba.—On the Montana Central line from Helena to Butte about 45 miles of track have been laid. The 28 miles which remain will be completed by the middle of July.

New Projects and Surveys.

Arizona & Southeastern.—The city of Tombstone, Ariz., has subscribed $20,000 to this enterprise.

Olympia, Black River & Chehalis.—This Washington Territory Company has for its incorporators, S. G. SIMPSON, JAS. K. MURPHY and GEO. SIMPSON, of Seattle.

Mexico.—A press dispatch from the city of Mexico June 16 says: "A concession has been granted, on liberal terms, for a railway from the important mining Town of Pachuca to Fort Tampico, the future Gulf terminus of the Central Railway. If this road is built it will give a very direct rail route from Tampico to this city. An important railway contract has been signed here, whereby the Mexican National Railway Construct on Company agrees to begin work in October on the railway from Armenia to the City of Colima. The State of Colima subsidizes the line independently of the Federal Government. It is proposed to push the line on to Guadalcazar. Money for this project is already on deposit here."

Pleasure Beach & Los Angeles Belt.—Incorporated in California to build a railroad 60 miles in length in Los Angeles Co. The directors are J. B. RALSTON of San Francisco, GEO. COOPER of DIXON, and J. W. GREENE of Sacramento.

Salt Lake City & Los Angeles.—Incorporated in California to build a railroad from Los Angeles to Salt Lake City, running through the State of California for 250 miles, by ISAAC TRUMBO, ALEXANDER BADLAM, WM. H. BROWN and GEO. BURGESS.

RAILWAY CONSTRUCTION IN 1888.

(See Map in Last Issue).

The following list, made up from our construction records, shows the track laid from Jan. 1, of the present year to date, or practically for the first 6 months of the year. We again request that any errors and inaccuracies which our readers may note in the above list, especially in regard to extensions which are now completed, be brought to our attention at once. For the summaries of work in the different States and sections see our editorial columns.

COMPANY.	MILES.
Canada.	
Brockville, Westport & S. S. M. Lyn to Brockv'e.	5.
Cen. New Brunswick. Norton toward Fredericktown	10.
Chatham. At Chatham, N. B.	2.
Massachusetts.	
Boston, Winthrop & Shore. In Winthrop	2.
New York.	
Brooklyn, Bath & West End. Coney Island to Unionville	2.
Grand Trunk. To Massena Springs	8.
Lackawanna & Pittsburg. To Hornellsville	10.
New Jersey.	
Williamstown & Delaware river. Glassboro' to Mullica Hill	6.
Delaware.	
Philadelphia, Wilmington & Balt. At Wilmington.	11.
Maryland.	
Baltimore & Ohio. To Savage Factory	1.
Pennsylvania.	
C. R. R. of N. J. (*Wilkesbarre & Scranton*). Minooka to Scranton	4.
Lehigh Valley. Fairview to Pleasant Valley	12.
Pitts., Shenango & L. Erie. Greenv'e to Amasa	3.5
Ohio.	
Marietta, Col. & Northern. Big Run to Stewart	4.
Penn. (*Pitts., Cinn. & St. L.*) To Hamilton	18.
Zanesv'e & Ohio river. Waterford to Harman	22.
Indiana.	
Midland Ry. of Ind. Ladoga to Brown's Valley	10.
Michigan.	
Chicago & Northwestern. Ishpeming to Michigamme and Republic	28.
Detroit, Lansing & No'n. Bet. Grand Ledge and Grand Rapids	35.
Toledo, Saginaw & Mack. Bet. Durand and E. Sag.	25.
Virginia.	
Norfolk & Western. Clinch Valley Extension	15.
Elkhorn Extension	8.6
North Carolina.	
Cape Fear & Yadkin Val. Pilot Mt'n. to Mt. Airy	14.
Durham & Oxford. Between Oxford and Durham	23.
Ga., Car. & No'n. Monroe, N. C., to Chester, S. C.	50.
Seaboard & Roanoke, Cameron to'd Carthage	4.5
Suffolk & Carolina, Chowan to Montrose Landing	2.
Wilmington & Weldon. Scotland Neck, south	5.
Wilmington Sea Coast. Wilm't'n to Wrightsv'e	10.
South Carolina.	
Carolina, Knox'v'e & W'n. near Greenville	3.
Char'n, Cinn. & Chic. End track to Catawba River	16.
Georgia.	
Atlanta & Florida. Toward Ft. Valley	55.
Chattanooga, Rome & Columbus. Chat. to Rome	90.
Cedartown to Carrollton	30.
Covington & Macon. Monticello toward Athens	35.
Ga. So'n & Fla. Between Macon and Valdosta	40.
Florida.	
Orange Belt. Tarpon Spr. to Clearwater	14.
St. Augustine & Palatka. At Palatka	1.5
Suwanee River, Hudson to Ellaville	17.8
Western of Fla., Belmore, west	1.5
Alabama.	
Anniston & Cinn. Attala to Cove Creek	11.
Alexandria to Duke's	6.
Cen. R. R. of Ga., Bet. Goodwater and Birmingham	25.
Between Dayton and Ozark	20.
Louisv'e & Nashv'e. Gate City Extension	7.
(*Nashv'e, Florence & Sheffield,*) To Florence	11.5
Kan. Cy. Mem. & B'ham. Ensley Jc. to Bessemer	11.
Mobile & B'ham. Wilson to Turkey Creek	15.
Rome & Decatur, Bet. Rome, Ga., and Decatur, Ala.	20.
Sheffield & Birmingham. To Jasper	33.5
Mississippi.	
Gulf & Ship Island, Biloxi river, north	15.
Tennessee.	
Louisv'e & Nashv'e. Shoal Creek to West Point	12.
Nashv'e & Knoxv'e. Lebanon, east	30.
Nashv'e & Tellico. At Athens	2.
Nashv'e, Chat. & St. Louis. Sparta to Bon Air	6.7
Tennessee Midland. Memphis, east	70.5
Troy & Tiptonville, Rives, west	2.
Walden's Ridge. Clinton to Oliver Springs	15.
Kentucky.	
Louis'v'e & Nashv'e. Barbourv'e to Pinev'e	16.
Louisv'e, St. L & Tex. Owensboro to Hawesv'e	28.
Louisv'e Southern. Bet. Louisv'e & Harrodsb'g.	77.
Maysv'e & Big Sandy. Bet. Maysv'e and Ashland.	25.
Maysville toward Cincinnati	10.
Illinois.	
Chicago, Burl. & Q. Bet. Walnut Jc. and Streator	30.
Grand Trunk Jc. Elsdon to C. & W. I. Jc	4.
Illinois Central. Rockford, east	54.
Jacksonv'e So'e'n. Driver's to Mt. Vernon	5.
Lake Erie & W'n. Bet. Bloomington and Peoria	15.
St. Louis, Alton & Spr. Alton to Elsah	12.
Wisconsin.	
Chicago & No'w'n. Lake Geneva to Williams Bay	6.
Ill. Central. Blanchardv'e to Dodgev'e	22.
Minnesota.	
Dul. & Iron Range. Tower to Ely	21.
Minn., S. Ste., M. & Atl. Vadnais Park to St. Paul	5.5
Nebraska.	
Burl. & Mo. R. To Alliance	23.
No Pac. Lawrence to Hastings	26.
Between Talmage and Crete	30.
Missouri.	
Cape Girardeau So'w'n. Wellsdale to Chaonia	2.5
Chicago, St. Paul & Kansas City. To St. Joseph	19.
Kan. Cy. & So'n. Bet. Kan. City and E. Lynne	48.
Kan. Cy., Ft. Scott & Gulf. Current River branch	40.
Miss. River & Bonne Terre. Bonne Terre, east	3.
Mo. Pac. To Boonville	50.
Kansas.	
Burl. & Mo. River. Blakeman to Wano	35.
Chic., Kan. & Neb. E. line Meade Co. to State line	64.
Kansas City & Pacific. Selma to Vance	4.
Indian Territory.	
Mo. Pac. (*Kan. & Ark. Val.*) Van Buren, Ark., toward Waggoner, Ind. Ter.	48.
Arkansas.	
St. L., Ark. & Tex. Quapano Lake to Argenta	32.
Canfield to Shreveport, La	47.
Louisiana.	
East Louisiana. Abita Spr. to Covington	4.
La. No. & So. Gibsland to Homer	20.
Texas.	
Ft. Worth & Denver City. Washburne to Panhandle City	16.
St. Louis, Ark. & Tex. Remer to Fort Worth	41.
Tex. & Pac. Strawn to Palo Pinto mines	4.5
Tex., Sabine Val. & No'w'n. Beckv'e to Carthage	10.
Montana.	
St. P., Minn. & Man. Gt. Falls to Sand Coulee	16.
Marysville Jc. to Marysville	5.
Helena toward Butte	45.
Washington Ter.	
No. Pac. (*Spokane & Palouse.*) To Genessee, Id.	14.
Seattle, L. Shore & E'n. Snohomish Jc. to Earle	6.
Oregon.	
Ore. & Wash. Ter. Pendleton to Wallula and Branch to Centreville	50.
Portland & Willamette Valley. In Portland and at Dundee Junction	2.
California.	
Atch., Top. & S. Fé. (*Cal. Cent.*) Perris to San Jacinto	19.4
Inglewood to Redondo Beach	10.
6.9 miles west of San Bernardino to Montrose	6.
Chino Valley. Chino to Ontario	5.8
San Diego, Nat Cy., & Otay. To La Presa	2.
San Francisco & No'n Pac. Pacheco to Napa	12.
San Gabriel Valley. Monrovia to Ramona	8.
So. Pac. Napa river to Santa Rosa	34.
Spinale Springs to Placerville	12.
Logan, south	65.
Madison, north	19.
Willows, west	20.
Colorado.	
Denver & Rio Grande. Florence to Coal Creek	3.
New Mexico.	
Denver, Tex. & Ft. Worth. 12 miles south of Trinidad to Texas State line	135.8

Contracting.

Reservoir.—The Albina Water Co., of Albina, Ore. has awarded the contract for the new reservoir to Wm. Jacobson, at $1,850. GEO. GOOD is President of the company.

The Clatsop County Road & Construction Co. has been incorporated at Astoria, Wash. Ty., by J. G. HUTTER, C. W. FULTON, and others. Capital stock, $10,000.

Railway Contracts.—*Eastern.*—P. Brennan of Duluth, Minn., has the contract for laying track on the Eastern Ry., of Minnesota. Plans have been prepared for warehouses and round houses at West Superior.

Tennessee & Coosa.—Danforth & Armstrong, of Birmingham, have a contract amounting to about $1,000,000 for grading, masonry and bridging on the uncompleted portion of the old road from Gadsden, Ala., to Guntersville, 36 miles; and the extension to Huntsville, 40 miles.

Atchison, Topeka & Santa Fé.—Ricker & Lee, of Galveston, Tex., have the contract for the extension from San Angelo to Ballinger at $40,000.

Georgia Pacific.—Contracts have been awarded as follows: McLaughlin Bros., Rome, Ga., 10 miles; Gibson & Copening, West Point, Miss., 9 miles; Jas. Sullivan, Selma, Ala., 12 miles; Dunn Bros., Birmingham, Ala., 7 miles; Copening Bros., Selma, Ala., 10 miles; Wm. Furguson, Union City, Tenn., 19 miles; John D. Inman, Troy, Tenn., 16 miles. Total, 83 miles.

Grand Trunk.—James A. McMahon, W. M. Shea and Geo. A. Begy have been awarded contracts for 17 miles of double track work from Coteau to Lancaster, near Montreal. The amount of the contracts is about $150,000.

Cast Iron Pipe and Specials.—The following proposals for 23 net tons of 12 in. straight water pipe, 155 tons of 10-in., 125 tons of 8-in., 200 tons of 6-in., 50 tons of 4-in. and 2,700 lbs. of special castings, have been received by the Executive Board, Rochester, N. Y.: New Philadelphia Pipe Works, New Philadelphia, O., $26 per ton for 12 and 10-in. pipe; $26.75 for 8, 6, and 4-in.; total, $17,066.75. Lake Shore Foundry, Cleveland, O., $26.70, $27, $27.50, and $28 for 12, 10, 8 and 6-in. pipe; 2¾ cts. per castings, $17,299.10. Donaldson Iron Co., Emaus; Pa., $26.26 per ton for pipe; 2½ cts., per lb. for castings, $17,526.43; Jackson & Woodin Co., Berwick, Pa., $26.25 for pipe, 2.4 cts. for castings, $17,526.75. Buffalo Cast-Iron Pipe Co., Buffalo, N. Y., $26.25 for pipe, 2½ cts. for castings, $17,553.75. Charles Miller & Son, Utica, N. Y., $27 for pipe, 2¾ cts. for castings, $18,036. Addyston Pipe & Steel Co., Cincinnati, O., $27.70 for pipe, 2 cts. for castings, $18,351.10. Warren Foundry & Machine Co., Phillipsburg, N. J., $27.60 per pipe, 2⅞ cts. for castings, $18,404.92. Meliert Foundry & Machine Co., Reading, Pa., $27.20 for 12 and 10-in. pipe; $27.60 for 8 and 6-in., $32.60 for 4-in., 2¾ cts. for castings, $18,668.10. E. D. Wood & Co., Philadelphia, Pa., $28.10 for pipe, 2½ cts. for castings, $18,743.30. McNeal Pipe & Foundry Co., Burlington, N. J., $28.50 for pipe, 2¾ cts. for castings, $19,034.25. Detroit Pipe & Foundry Co., Detroit, Mich., $29 for pipe 2.35 cts. for castings, $19,281.50. The contract was awarded to the Buffalo Cast Iron Pipe Co.

Asphalt Paving.—The Department of Awards, Pittsburg, Pa., has awarded the contract for paving Diamond Square with vulcanite asphalt to Booth & Flinn at $3 39 per sq. yd.

Gas Works.—Only one bid for the contract to supply the city with an extra amount of gas was received June 5 by the mayor of Philadelphia, Pa. The bid was from the Philadelphia Gas Improvement Co.; President, WM. L. ELKINS, Jr.; Treasurer, GEO. D. WIDENER; and offered the city the choice of four different processes. The following table briefly summarizes the figures contained in the bid, all of them being for water gas.

	Price per 1000 cu. ft.	Royalty.	Candle Power.	Carbonic Oxide.	Cost of Works.
Flannery Process	45 cts.	2½	22	22⅝	$250,000
Springer & Jeremy	42 cts.	2½	22	23⅝	465,000
Hanlon & Headley	37 cts.	2½	22	22⅝	275,000
Tassie & Germanousky	48. cts.	3½	30	22⅝	500,000

The Flannery system is now in operation in New York, Chicago, Middletown, Norwich and Duluth; the Springer & Jeremy in Chicago, Lima, O.; San Francisco and other places; Hanlon & Headley in Chicago, Flint, Mich., Gourd Island and Buffalo, and the last on the list in the New York Equitable Gas Works and in Buffalo. The Flannery Gas Co. sent a communication stating that it claimed the right to control the Flannery patents and would bring suit if a contract for this process was awarded to the Philadelphia Gas Improvement Co.

Artesian Wells.—W. H. FULGHUM, of Riddleville, Ga., contemplates putting down an artesian well and wants prices of tools, pipe, plant, etc.

Street Railway.—The Metallic Street Railway Construction Co., of Albany, N. Y., has the contract for building a street railway at Scranton, Pa., for the South Scranton Electric Ry. Co.

Colorado State Capitol.—The contract for the stone and brick work on the new capitol at Denver, Col., was awarded June 5 to Geddis & Seerie, of Denver, at $700,000. Other contracts will be let later on. GEORGE T. CLARK is Secretary of the Board of Capitol Managers.

Dummy Railways.—At Milledgeville, Ga., a company has been organized to build a 3 mile dummy line. Contractors for track and equipment should address J. W. MCMILLAN.

At Anniston, Ala., the Aderhold Park & Dummy Line Co. will build a line to Aderhold Park. Work is to be commenced shortly.

Depot.—The contract for the new union depot at Springfield, Mass., has been awarded to Norcross Bros., of Worcester, Mass. The Boston & Albany R. R. Co., will spend $500,000 to $600,000 on the depot and other improvements, add the depot will also be used by the Connecticut River; New York, New Haven & Hartford, and New York & New England roads.

Irrigation Canals.—The Land & Water Co., of Traver, Cal., received proposals from C. N. Wright, of Hanford, Tulare Co., Cal.; F. Stevens & Sons, of Fresno, Cal., and W. R. Neil, of Traver, Cal., for the construction of its latest canal. The contract was awarded to W. R. Neil. Bids generally run from 5 to 10 cts. per cu. yd. S. F. EARL is Secretary of the company.

Oil Pipe Line.—The great pipe-line of the Standard Oil Co., which is to convey oil from the Lima field to Chicago, is moving along at a rapid pace. The pipe-layers have reached the vicinity of Laketon, Ind., where one of the pumping stations is to be located, and where it is understood the company will erect large buildings.

Court House.—The Board of County Commissioners, Denver, Col., have received plans, specifications and estimates for a court house and jail from the following architects: O. Bulow, Denver, $120,000; F. C. Eberley, Denver, $190,000; F. E. Edbrooke & Co., Denver, $197,288; Jackson & Belts, Denver, $209,000; William Lang, Denver, $225,535.15; James Murdock, Denver, $235,793; R. S. Roeschlaub, Denver, $379,414.95; P. J. Pauly, Longmont, Col., $406,700.

Pipe Laying.—The following proposals for laying water-pipe have been received by the Board of Public Improvements, St. Louis, Mo.; and the contract has been awarded to Patrick O'Donnell:

	Pat. O'Donnell		Fruin-Bambrick Con. Co.	
	price	amount.	price	amount.
240 ft. of 48-in. pipe	2.65	$ 636.00	2.76	$ 648.00
4800 ft. " 36-in. "	1.60	7680.00	1.80	8640.00
100 ft. " 12-in. "	.30	30.00	.35	35.00
50 ft. " 8-in. "	.25	12.50	.28	14.00
100 ft. " 6-in. "	.20	20.00	.22	22.00
5 fire plugs set	10.00	50.00	7.00	35.00
1500 lbs. of wrought-iron straps and bands	.07	105.00	.07	105.00
Total		$8,533.50		$9,499.00

Bridge Contracts.—*Saco, Me.*—The Berlin Bridge Co., of East Berlin, Conn., has the contract for an iron bridge to replace the Gooch Island bridge between Biddeford and Saco. It will be completed by July 1.

Warren, Mass.—The Berlin Iron Bridge Co., of East Berlin, Conn., has the contract for the iron bridge at West Warren.

Ocean Grove, N. J.—The Pittsburg Bridge Co., of Pittsburg, Pa., has the contract for two iron bridges over Wesley Lake, for the Ocean Grove Association, connecting with Asbury Park.

Frederick, Md.—The Smith Bridge Co., of Toledo, O., has the contract for a bridge across the Potomac river at Point of Rocks; it will be 1,400 ft. long and 16 ft. wide, and will cost $45,000. The bridge is for the Potomac Bridge Co.; President, Jos. D. BAKER, of Frederick, Md.

Gaysport, O.—The Smith Bridge Co., of Toledo, O., has the contract for new spans of the Gaysport bridge to replace those destroyed by the storm recently. The contract price is $9,995. The company bid $6,700 for a wooden bridge, and the Mt. Vernon Bridge Co., of Mt. Vernon, O., bid $10,850 for an iron structure.

Wilmington, N. C.—The Edge Moor Iron Co., of Wilmington, Del., has the contract for a bridge over the Cape Fear river, and another over the North East river both for the Wilmington Railway Bridge Co. The former is completed and work is in progress on the latter.

Oxford, Ala.—The Birmingham Bridge Co., of Birmingham, Ala., and Geo. H. Crofts, of Atlanta, Ga., have contracts for bridges at $2,980 and $3,250 respectively.

Columbia, Ala.—The Atlanta Bridge Co., of Atlanta, Ga., has the contract for a bridge 300 ft. long, across the Chattahoochee river, for the Georgia Central R. R.

Tampa, Fla.—The King Iron Bridge & Mfg. Co., of Cleveland, O., has the contract for the bridge over the Hillsborough river.

Greenwood, Miss.—The New Jersey Steel & Iron Co., of Trenton, N. J., has the contract for an iron drawbridge over the Yazoo river for the extension of the Georgia Pacific R. R.

Austin, Minn.—Horace E. Horton, of Rochester Minn., has the contract for three iron bridges for the county commissioners.

Argentine, Kan.—The Rosedale Iron Co. has the contract for the new county bridge across the Kaw river.

Sewers.—*Lancaster, Pa.*—The following proposals were received June 18 by the Street Committee:—North Queen St. sewer, 494 ft. long, 24 ins. diameter, 10 ft. deep; C. W. Schwebel, $500; John Kendig, $509; Kitch & Smith, $766; Bernard Malone, $1,482. The contract was awarded to C. W. Schwebel.——Duke St. sewer, 1,609 ft. long, 36 ins. diameter, 9 ft. deep, 9 inlets, 3 manholes; John Kendig, $2,482; I. F. Stauffer, $3,016; Kitch & Smith, $3,330; Bernard Malone, $5,479. The contract was awarded to John Kendig.——Bernard Malone has just completed an intercepting sewer in the northeast section of the city, 2,238 ft. long, 6 ft. diameter, $7 per lin. ft.——S. C. SLAYMAKER is City Engineer.

Street Work.—*Holyoke, Mass.* The Highway Committee opened bids recently for laying 15,000 sq. yds. of paving. The prices ranged from 17½ cts. to 33¼ cts. per sq. yd.

Brooklyn, N. Y.—The following proposals for grading and cobblestone paving have been received by JOHN P. ADAMS, Commissioner of City Works: On Ivy St.: Henry A. Nolan, $3.69 per lin. ft.; Thos. McDonald, $3.63; Henry Mogk, $3.19; John Hickey, $2.99.——On Bleecker St.: Henry A. Nolan, $6.13 per lin. ft.; Henry Mogk, $5.99; John J. O'Brien, $5.75 per ft.——On Braxton St.: Patrick O'Hara, $3.49.

Detroit, Mich.—The Board of Public Works has awarded paving contracts as follows: Talbot Paving Co., $10,448.91; S. R. Thompson, $3,727.93; Eugene Robinson, $17,827.98.

St. Paul, Minn.—The Board of Public Works has awarded the contract for grading Macalester Ave. to James Kavanaugh, at $10,490.——The engineer's estimate for pine block paving on Kent St. is $7,504.

Sewers.—*Chicopee, Mass.*—The Selectmen have awarded the contract for laying 1,000 ft. of 21-in. pipe sewer on Front St., to M. J. Lynch, at 63 cts. per ft. Other pipe sewers will be laid.

Brooklyn, N. Y.—The following proposals for a sewer in District No. 37, have been received by JOHN P. ADAMS, Commissioner of City Works: John S. Bogert, 12-in. cement pipe, $1.60 per lin. ft.; manholes, $40 dollars each; street basins, $1.10.

Saratoga, N. Y.—The following proposals have been received for building pipe sewers: Daniel Leary, Saratoga Springs, 85 cts. per ft., complete, including manholes; Adam Miller, Saratoga Springs, 75 cts. per ft.; manholes, $60 each. The contract was awarded to Daniel Leary.

Springfield, Ill.—Contracts for sewers have been awarded as follows: Eighteenth St. sewer; C. Cunningham, 2,500 ft. of sewer, $1.69 per ft.; inlet pipes, 43 cts per ft; manholes, $10.——Bancroft branch sewer; C. Cunningham, 30 in. sewer, 98 cts. per ft.; inlets, 43 cts. per ft.; manholes, $9.50.——Bond St. sewer; 42-in., 36-in. and 24 in. sewer, $1.15, $1.07 and 98 cts. per ft.; inlet pipe 43 cts. per ft.; manholes, $10.——Amos branch sewer; Henry Nelch, 36 in. sewer, $1.14; inlets, 41 cts. per ft.; manholes, $12.

Austin, Ill.—The following proposals for a sewer 28,000 ft. long, in the town of Cicero have been received by E. S. Austin, Town Clerk: John Kelly, Austin, $1.40 per ft.; John McKenna, Brighton Park, Ill., $1.43. The contract was awarded to John Kelly.

Street Work.—The following contracts have been awarded by the Board of Contract & Apportionment, Albany, N. Y.:—Granite paving on Park Place; Jacob Hollier, of Albany; granite, $2.87 per sq. yd.; relaying granite, 90 cts. per lineal foot; new curb, 92 cts. per lineal foot; resetting old curb, 40 cts. per lineal foot; credit for cobble, 5 cts. per sq. yd.; credit for old curb, 2 cts. per in. ft.; total, $1,492.56.——Granite paving on La Fayette St.; Jacob Hollier, of Albany; granite, $2.87; curb, 92 cts., circular curb, $ .15; crosswalks, 30 cts. per sq. ft.; old curb reset, 40 cts.; old cobble, 5 cts., old curb, 2 cts.; old crosswalks, 20 cts.; total, $4,861.67.——Granite paving on Orange St.; A. N. Brady, of Albany; granite, $2.85; old granite reset, 50 cts. and 70.; curb, 92 cts. resetting old curb, 50 cts. and 60 cts.; circular curb, $1.05; crosswalks, 34 and 35 cts.; relaying sidewalks; 60 cts. per lin. ft.; flagging, 20 cts. per sq. ft.; brick, $80 per 100; receiving basins, $68; totals for two divisions, $3,760.25 and $2,138.50.——Improving Knox St. alley Jacob Hollier, of Albany; 10 cts. per cu. yd. for excavating and 15 cts. per cu. yd. for filling.

City Work.—The Public Improvement Committee, Kansas City, Mo., has awarded contracts as follows: Paving Ninth St.; Andrew Jaicks, $1.94 per sq. yd.; Grading Woodland St.; O'Flaherty & Crowley, 18 cts. per cu. yd. of earth and 45 cts. per cu. yd. of rock embankment. Curbing Oak St.; M. Walsh, 65¼ cts. per lin. ft. Curbing Harrison St., James Armstrong, 70 cts. Sidewalk 8 ft. and 10 ft. wide; Thos. Kneaves, 47½, 50 and 39 cts. Paving Wyandotte St., Barber Asphalt Paving Co., $2.80 per sq. yd. Cedar block paving on 8th St.; A. J. McBean & Co., $2.07 per sq. yd. Paving Troost Ave., E. Saxton, $2.10 per sq. yd. Grading 10th St.; Pat. Keating, 28 and 45 cts. per cu. yd. for earth and rock excavation. Grading alley; G. K. White, 23¾ cts. per cu. yd. Grading Woodland St., Wm. T. Crowley, 17¾ and 15 cts. for earth and rock excavation. Grading Hawthorn Ave.; Tim Brosnehan, 14¾ cts. per cu. yd. Grading Woodland Ave., Pat. McDonald, 15¾ cts. Curbing Holmes St., 64 cts. per lin. ft.

Bridges.—J. A. SEYMOUR, City Engineer, Bradford, Pa., has received the following proposals for the construction of two bridges: Variety Iron Works, Cleveland, O., $1,552; Smith Bridge Co., Toledo, O., $1,573.25; King Iron Bridge & Mfg. Co., Cleveland, O., $1,563; Berlin Iron Bridge Co., East Berlin Conn., $1,597.23, or $1,547.23 without lamp posts; Groton Bridge Co., Groton, N. Y., $1,587; Massillon Bridge Co., Massillon, O., $1,595; Nelson & Buchanan, Chambersburg, Pa., $1,900 and $1,552 for high and low truss respectively; Dennithorne & Son Phoenixville, Pa., $2,008.80

Lighthouse.—Carkeek Bros., of Seattle, Wash. Ty. have a contract for a lighthouse on Destruction Id.; the contract price is $100,000.

Street Sweeping Machine.—At New Orleans, La., a street sweeping machine, similar to those in use at Washington, D. C., and elsewhere, is to be purchased by W. B. Leonard and F. C. Ford for sweeping asphalt pavements.

The Oregon Railway Extension Co. has been organized at Portland, Ore., by W. H. HOLCOMB, W. H. CORBETT, HENRY FAILING and C. H. LEWIS, to construct railroads and other works. Capital stock, $1,000,000.

Creosoting Works.—The Southern Pacific R. R. Co., will erect creosoting works at San Pedro, Cal., to treat piles for wharf work. The works will cost $30,000.

Lake.—At Providence, R. I., Shaw & Whittlesey, the contractors, are at work on Lake No. 3 in Roger Williams Park. The city approriated $31,000 last Fall for excavating a portion of the swamp and making a lake. The swamp is being dredged out to a depth of 5 ft. and the bottom will be floored with 2-in. planks laid on 3 × 4 in. joists; the floor being covered with 18 or 24 ins. of gravel and sand. The lake will be 600 ft. by 200 ft. and will be connected with lake No. 2 by a stream.

Graphite Paint.—The Delaware river bridge, 11,275 feet long, of the Trenton City Bridge Co., Trenton, N. J., was painted with graphite paint some years ago, and inspection now proves the paint to be in perfect condition. The paint was supplied by the Jos. Dixon Crucible Co.

The Volker & Felthousen Mfg. Co., of Buffalo, N. Y., has its works busy with pumping plants for water works. It is now completing plants for the following works: Jamestown, N. Y.; Albion, N. Y.; Phoenix, N. Y.; Boothbay, Me.; Pierce City, Mo.; Pine Bluff, Kan.; Holdrege, Neb., and Owensboro, Ky.

Pig Lead.—The Water Board, Minneapolis, Minn., has received the following proposals for 40 tons of pig lead: Hodgman Bros., $3.75 per 100 lbs.; Northwestern Shot Co., $3.80; H. P. Rugg & Co., $4. The contract was awarded to Hodgman Bros.

Proposals Open.

Water Bonds.—Water-works bonds for $30,000 at a rate less than 5 per cent. HUGH GILCHRIST, Chairman of Water Committee, Windsor, Vt.

Reservoir.—ROBERT H. MARTIN, Chief Engineer of the Water Dept., Baltimore, Md.

Drawbridge.—Iron drawbridge at New Bridge, Bergen Co., N. J.: 110 ft. between abutments, 18 ft roadway. JOHN G. ZABRISKIE, Rochelle Park, N. J. June 25.

Street Work.—Grading, cobblestone paving, flagging sidewalks. JOHN P. ADAMS, Commissioner of City Works, Municipal Building, Brooklyn, N. Y. June 26, 27, 28.

Setting Gas Lamp Posts.—JOHN P. ADAMS, Commissioner of City Works, Brooklyn, N. Y. June 28.

Curbing.—Granite curb; 10 905 lin. ft. of 16 ins. depth, 7,875 ft. of 12 ins. depth. FRANK E. REBARER, Savannah, Ga. June 27.

Street Work and Sewer.—Regulating and macadam paving; also sewer. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City. June 27.

Street Work, Drainage, Etc.—Receiving basins and inlets; stone steps; retaining walls, curbing, etc. Also floor tiling and other work at the Metropolitan Museum of Art. THE COMMISSIONERS OF PUBLIC PARKS, 49-51 Chambers St., New York City. June 27.

Pumping Engine.—One engine; daily capacity 5,000,000 galls.; pressure 90 lbs., fire pressure 150 lbs. Also purchase of old engine. J. D. COOK, Toledo, O., Consulting Engineer. THE TRUSTEES OF WATER-WORKS, Springfield, O. June 28.

Street Work.—Curbing, guttering, sidewalks, rubble stone masonry, 12 and 15-in. culvert pipe, 36 and 48 in. brick culverts. THOS. J. LANAHAN, Clerk of Board of Contract, Albany, N. Y. July 2.

Bridge.—Over Fishing creek. D. B. SANFORD, Milledgeville, Ga. July 3.

Canal.—Construction of the Columbia canal; also separate bids for dam, waste weir, culvert, etc. BYRON HOLLEY, Chief Engineer, Columbia Canal, Charleston, S. C. July 5.

Grading.—About 150,000 cu. yds. Bids per cubic yard. Capt. J. W. JACOBS, Asst. Q. M. U. S. A., Atlanta, Ga. July 7.

Columns.—Cast-iron columns. THE COMMISSIONERS OF THE NEW CITY HALL, San Francisco, Cal. July 10.

WATER.

Los Angeles, Cal.—The Stoneman Water Co. has been incorporated by GEO. STONEMAN, J. C. WALLACE, F. B. STURGE, WM. J. MCCALDEN, and F. W. HALL. Capital stock, $15,000.

The Pueblo Light & Heat Co. has been incorporated at Pueblo, Col., by M. H. TRITCH, J. H. BENNET and JOSIAH HUGHES to supply electricity for light, heat and power. Capital stock, $100,000.

Irrigation Water Supply.—The Cucamonga Land & Fruit Co., of Cucamonga, Cal., is tunneling extensively for water. Over 2,700 ft. have been tunneled, 500 ft. being through rock; 600 ins. of water have been obtained; 4000 ft. more will be tunneled.

Holyoke, Mass.—The Water Commissioners have decided to build the proposed storage reservoir at the Whiting Street brook, to increase the water supply. The reservoir will be built on the upper level and will afford a flowage area of about 100 acres or more. The plan is to build a dam about 25 ft. high, to cost about $50,000.

The Independent Hydrant, manufactured by the Chapman Valve Co., was tested recently at Portland, Me. The hydrant is made to accommodate four lines of hose, and each outlet is controlled by a special valve that can be opened and shut at pleasure, and it is claimed that it will supply four engines, throwing 2 streams each. The hydrant was tested in this way, with satisfactory results.

New York City.—The New York Board of Fire Underwriters recently considered the question of the inadequate water supply of the city and passed the following resolution: "That the Committee on Water Supply be directed to call the attention of the Mayor of this city, and of the Department of Public Works, to the want of water for extinguishing fires as indicated by the numerous disastrous fires which have occurred since the commencement of the present year, and particularly shown by the records of the Fire Department.

Syracuse, N. Y.—The Water Commission bill has been signed by the Governor, authorizing the mayor to appoint six water commissioners. The Board is to be strictly unpartisan, and the mayor will not be an ex-officio member. The sum of $12,000 is appropriated to enable the commission to pursue its investigations of all the practical sources of supply. Most of the money will probably go to expert hydraulic engineers The commission is expected to report to the Common Council by January, 1889.

Carlyle, Ill.—The water-works company has filed an appeal in the case which was decided against it at the May term of Circuit Court for non-compliance with its contract in the erection of a system of water-works for the city of Carlyle. The case will either go to the higher courts, or in the meantime be compromised; the latter, however, seems the most probable result, as the contractors would be in quite a predicament should the case be decided against them by the Supreme Court, and the city would not then be likely to compromise.—St. Louis, Mo., *Globe Democrat*.

Santa Barbara, Cal.—The supply well for the new water-works, which has been under construction for 6 months, has been completed. The chief difficulty encountered was in the sinking of the caisson, which was done by dredging out the muck, blue clay and hard pan through which the well passed. The result of a pumping test of 50 hours shows the present capacity of the well to be over 1,000,000 galls. per day, and an additional supply can be obtained in the future by sinking tube wells at the bottom of the present well. The supply is stated to be permanent. The work was done under the supervision of W. R. COATS, engineer for the De La Guerra Garden Spring Water Co.

East Orange, N. J., Sewerage.—The sewerage system and sewage disposal works are nearly completed. There are 26 miles of 8 to 24-in. vitrified, salt glazed, stoneware pipe, carrying house sewage only and no storm water; these pipe systems discharge into an oval brick sewer leading to the disposal works. After being mixed with chemicals in a tank, the sewage flows to a sludge well 12 ft. square and 16 ft. deep, and thence to two precipitation tanks, after which the liquid is run to the disposal grounds, and the solid matter is pressed into cakes to be used for fertilizing. The grounds can accommodate the sewage of a population of 40,000 people, but East Orange has as yet only 12,000. The sewerage system and disposal works were designed by and built under the supervision of CARROLL PH. BASSETT, C. E., of Newark, N. J.

Springfield, Ill.—The present supply of water comes directly out of the river with the result that it is never pure, and when the river is high it is always full of dirt and other impurities. To remedy this, a large well was sunk which produces about 750,000 galls. per day. The quality of this water is always good, but the quantity is not sufficient to meet the demands of the whole city, and until it is increased, cannot be made available even in part. This well is 50 ft. diameter by 53 ft. deep.

To remedy this trouble, it is proposed to drive a tunnel 600 ft. in length which will give an additional daily supply of 2,500,000 galls. This quantity will be ample for some time to come, and can be increased at any time by a farther extension of the tunnel. It will be situated about 25 ft. below the surface of the ground, 9 ft. below low water mark, directly in a bed of coarse sand and gravel, the best water bearing stratum to be found in the valley of the river. The city has voted in favor of carrying out this work; and the Water Commissioners are authorized to spend not exceeding $10,000 for tunnels, aqueducts or filtering galleries.

Sumter, S. C.—The proposition made to the Town Council by H. D. GARDER, C. E., is about as follows: He will furnish to the part of Sumter known as the fire limits, a system of driven wells with a capacity of 700,000 to 1,000,000 galls. of water per day; to be conveyed by 8-in. and 6 in. pipes to the business portions of the town, with 15 hydrants; also 25 are electric lights, of 2,000-candle power each. The annual running expenses of the whole will be less than $1,900. This amount may be reduced $800 or $900 by hiring out a portion of the 25 lights. The whole cost of the water-works and electric lights will be $23,750 in 6 per cent. bonds. This appears to be a reasonable and practicable plan, and will be very advantageous to the town. A considerable amount is now expended for oil and gasoline lights, with a very indifferent result. The supply of water for extinguishment of fires is very inadequate. The town pays out over $12,000 in insurance premiums, which would be greatly reduced by good water-works. The systems proposed can be indefinitely enlarged, both as to the water and electric lights. Council have not yet considered the proposition.

Water Supply of Iquique, Chili.—The *Financial News*, of London, England, recently devoted considerable space to the discussion of the different projects for supplying water to this city. The Iquique Water Co. was organized in 1885, with a capital of $1,750,000 to acquire and operate under a concession granted by the Chilian government to Thomas Hart. It was then stated by parties interested in the Nitrate Railways that water was plentiful at Iquique; being supplied by Mr John T. North. For some time there was considerable newspaper correspondence as to the quality and quantity of the supply, Mr. North taking active part, in opposition to the water company, and the engineers' reports were contemptuously referred to. Only a few months ago, however, the Tarapaca Water-Works Co. was organized for the same purpose as the former company but was also to acquire the plant used by Mr. North, and the same statements were made by this company as to the quality and quantity of the water and the demand for the same, and again quoting the engineer's reports, but this time unchallenged, for the reason that the opponents to the former scheme had made a deal with the new company and withdrawn their opposition and their contradictory statements. At present the new company holds the field, and has good names on its engineering staff. The project of the Tarapaca Water-Works Co. was noted in ENGINEERING NEWS, March 31, page 259.

Electric Lighting.—***St. Johnsbury, Vt.*** The village trustees have been authorized to have the village lighted by electricity and to expend $1,300 for the purpose during the year.

Brockport, N. Y.—The Brockport Electric Light Co. has been incorporated by FRANCIS H. LEONARD, GEO. D. MORGAN, GEO. C. GORDON and others. Capital stock, $15,000.

Harrisburg, Pa.—The contract for lighting the city has been awarded to the Excelsior Electric Co.

Zanesville, O.—The Zanesville Edison Electric Light Co. has been granted permission to operate in the city.

Wabash, Ind.—The new electric light system was inaugurated June 14, and proved to be a success. There are 127 incandescent lights in the city, which is now thoroughly lighted. The Heisler system of lighting is used.

Greenville, S. C.—The City Electric Light Co. is putting up poles, etc.; the Brush system will be used.—The owners of the gas works will put in a Thomson-Houston plant and enter into competition.

Columbia, S. C.—A Thomson-Houston plant for electric lighting is to be put in.

Jacksonville, Fla.—The mayor is receiving bids for an electric lighting plant.

Pensacola, Fla.—The Pensacola Electric Light & Power Co. has been organized and will put in a Thomson-Houston plant. President, B. R. PITT; Vice-President, F. C. BRENT; Secretary, E. S. QUINA.

Natchez, Miss.—The Natchez Gas Light Co. will put in an electric plant.

Kalkaska, Mich.—The electric light system has been put in operation and works satisfactorily.

Delavan, Ill.—The City Council is considering the question of putting in an electric light plant.

Monroe, Wis.—The Monroe Electric Light & Power Co. has been incorporated by WM. P. BRAGG, E. G. GREEN and B. S. WOOD. Capital stock, $12,000.

Denver, Col.—The Colorado Electric Co. has been awarded a contract for 5 years at $20 per lamp, $2 less than the old contract price.

Santa Clara.—An electric light franchise has been granted to the Electric Improvement Co., of San Francisco.

Santa Rosa, Cal.—An electric light plant is to be put in.

Water-Works.—***Maine.***—York Beach. The water-works are under construction and a supply will soon be furnished. The water will be taken from an artesian well and pumped to a tank of 25,000 galls. capacity, located on high ground at an elevation of 40 ft.—Tilton. Water-works are projected.—Bath. The water-works have been sold to H. M. Payson & Co. bankers, of Portland, for $250,000. The works will be improved and extended.

Massachusetts.—Ashfield. A water supply for fire protection is contemplated.—Holyoke. City Engineer ELLSWORTH has submitted to the Water Commissioners plans for the storage reservoir at the Whiting Street brook.

Vermont.—Windsor. The corporation of the village of Windsor has voted to construct water-works in accordance with the plans submitted by their engineer in 1887. HUGH GILCHRIST is Chairman of the Water Committee. GEO. H. LELAND, of Providence, R. I., is the Engineer. The town has issued bonds for $30,000, and the bonds are now for sale.

New York.—Syracuse. The Syracuse Water Co. proposes to obtain an additional supply of water from gang wells.

Pennsylvania.—Scranton. A system of water-works is to be built by Caldwell, Wilcox & Co., of Newburg, N. Y.—Scottdale. Work will be commenced shortly on the new water-works.—Morristown. Pipes are to be laid to supply suburban places with water.—Irvin. Water works are to be built.

Tennessee.—Troy. Water-works are to be put in. For particulars address JOHN B. INMAN.—Brownsville. The city has passed an ordinance awarding a franchise for water works, and work will be commenced shortly.

Alabama.—Tuskaloosa. Several car loads of pipe for the water-works have been delivered.—Calera. The Chemical Co. has sunk a well 20 ft. deep and has obtained a supply of 150 galls. per minute.

Michigan.—Owosso. The City Council has authorized the issue of $50 000 in bonds, to be used in the construction of water works.

Illinois.—Kankakee. The city is experimenting with a water supply from the St. Peter sandstone.—South Evanston. The village is now supplied from artesian wells, but since the construction of the new works the supply will be drawn from the lake and pumped to a stand-pipe 113 ft. high by two duplex pumps of 2,000,000 galls. daily capacity.

Minnesota.—St. Paul. On Jackson St. 12 in. pipes are to be laid to replace the present 6 in. pipes. The larger pipes will also be laid on other streets later.

Missouri.—Kansas City. The work of repairing the large settling basin at Quindaro has been nearly completed, and it is not thought there will be any further trouble.—Marceline. The Atchison, Topeka & Santa Fè R. R. Co. has completed a reservoir within the city limits with sufficient capacity to supply a city of 10,000 people, its area being nearly 40 acres, with an average depth of about 20 ft. Water for family purposes is found everywhere by digging from 20 to 60 ft. This water is of the very best quality, cold, clear, and pure. It seems to flow through a great underlying gravel bed and is therefore well filtered.

Texas.—Cuero. Water-works are to be built; there will be 6 miles of pipe, and pumping machinery with a daily capacity of 500,000 galls. The contractor is C. N. Holmes, of Seguin, Tex.

Canada.—Berlin, Ont. The water-works are being pushed to completion; the well is being sunk and more than a mile of pipe is laid each week. It is expected that the works will be ready for operation by the middle of July.

Special Reports of Water-Works Construction.

THE ENGINEERING NEWS MANUAL OF AMERICAN WATER-WORKS is now being compiled, and will be *indispensable* to every manufacturer, engineer and contractor in any way interested in Water-Works construction and maintenance, and will be of great value to Water Works superintendents and projectors of new works.

Superintendents of water-works and water companies will wish to see correct and complete data concerning their Works in our MANUAL, and to ensure this they should send in reports *at once* upon the blanks which we have already sent to every Water-Works office in the United States and Canada. Many have delayed their report, and if the blanks we intended for them have been lost in the mail, or mislaid, we will send more upon request.

We *must* have a report from every public water-supply system in North America, so those who reply to our inquiries at once will save a second inquiry. We also wish to know of *every* new Water-Works plant in process of construction, and of *every* new project in this line. We will send to any one desiring them, blanks upon which reports can be made.

Further details of the MANUAL will be advertised later. We abstract from our special reports for the MANUAL the following items of current interest:

CENTREVILLE, R. I., June 12, 1888.

EDITOR ENGINEERING NEWS:—The Warwick & Coventry Water Co. was organized last week under a charter from the State with E. LAPHAM as President and H. B. BARTON, Secretary. They propose to supply water to the villages in Warwick and Coventry lying along the south branch of the Pawtuxet river, and have issued $50,000 of stock. The stand-pipe system will be used, water being pumped from wells near the river. The population to be supplied eventually is about 8,000 which would require 14 miles of pipe, but at present only three villages with a population of 4,000 will be supplied. This will require 6¼ miles of pipe, and 60 hydrants. HERBERT B. BARTON,
Secy. Warwick & Coventry Water Co.

ROME, N. Y., June 16, 1888.

EDITOR ENGINEERING NEWS:—Contracts for a system of water-works at Sing Sing, N. Y., will probably be let July 12. The village has voted to bond itself to the amount of $150,000 for the construction of the works and a commission has been appointed to have charge of the matter of which JNO. F. TRUESDELL is Chairman. CHAS. W. KNIGHT, of Rome, N. Y., is Engineer of the works. The supply will be from three brooks, the water being impounded at an elevation of 188 ft. (Croton datum) and conveyed by gravity to pumps on Croton bay, forcing the water to an intermediate service reservoir near the village at an elevation of 326 ft. From this reservoir, water will be drawn to an intermediate, and also to a low service distribution system. There will also be a high service reservoir at an elevation of 400 ft. The population is about 7,000. It is hoped that the works will be completed this year. CHAS. C. HOPKINS.

FREEHOLD, N. J., June 12, 1888.

EDITOR ENGINEERING NEWS:—We are trying to get the town to build water-works but no definite action has yet been taken. It has been proposed to sink artesian wells and pump water to a stand-pipe at a cost of $35,000. Our population is 3,000. JAS. S. YARD.

WELLSTON, O., June 11, 1888.

EDITOR ENGINEERING NEWS:—A. C. REED, of Chicago and F. S. HINKLEY have contracted with the village to put in a system of water-works, the hydrant rental to be $58 each. Surveys have been made, but no sub-contracts have yet been let, and the matter is quite indefinite save that we expect work will begin soon. The proposed source of supply is Raccoon creek, one mile from town. Our population is 5,000. ADAM SCOTT, *Mayor.*

FRANKFORT, Mich., June 16, 1888.

EDITOR ENGINEERING NEWS:—The village expects to build works this summer, but the Council has not yet decided what plan to adopt. There is an opening here for some good contractor. CHAS. BURMEISTER.

ST. IGNACE, Mich., June 11, 1888.

EDITOR ENGINEERING NEWS:—The question of bonding this city to the amount of $40,000 for the purpose of constructing a system of water-works was submitted to a vote of the qualified electors of the city at the annual election held April 2, and resulted in 513 votes in favor of and 71 votes against the issuing of bonds. The population of St. Ignace is 3,500 and it previously had a bonded debt of $11,900 and a floating debt of $2,190. Its assessed valuation is $200,000, but judging from recent sales the real value of the taxable property of the City is $1,500,000.
WM. SAULSON, *Mayor.*

OXFORD, N. C., June 11, 1888.

EDITOR ENGINEERING NEWS:—Water-works have just been proposed for this place with every chance for immediate success. Water may be taken by pumping from either of three possible sources: a large well, Tar river, or Fishing creek. The cost of the works will be $25,000 and both the City and the Oxford Electric Light, Power & Water Co. will issue bonds for their construction. H. C. HERADEN is President of the company, and J. A. WILLIAMS can give information regarding the proposed works. It is thought that contracts will be let in September. R. W. WINSTON.

HINESVILLE, Ga., June 14, 1888.

EDITOR ENGINEERING NEWS:—We have a mineral spring, 900 ft. from the center of our village, which has a flow of 700 galls. an hour, and 300 galls. an hour would be sufficient to supply our population of 500 with water. We propose to drive a water-wheel with the balance, lifting water 10 ft. to a reservoir from which it will be conveyed by gravity to the village. We wish information regarding some kind of pipe which will not injure the water and also regarding a water-wheel. O. C. SMITH is President of our company, which is known as the Hinesville Water-Works Co. J. M. DARSEY.

WASHINGTON, Ga., June 11, 1888.

EDITOR ENGINEERING NEWS:—Our town needs water-works, and I think a good man could obtain a contract by working for it. No definite steps have yet been taken by the town, but in case works are built the supply will be taken from a well and pumped to a stand-pipe. Our population is 3,000. T. BURNELL GREEN.

BRISTOL, Tenn., June 11, 1888.

EDITOR ENGINEERING NEWS:—W. W. TAYLOR & Co are to put in water-works to supply this place and Goodson, Va. Particulars cannot now be given, save that water will be taken from springs about a mile distant and that the village will pay $40 each for such a number of hydrants as it chooses to take.
J. A. BRONSON, *Town Recorder.*

JERSEYVILLE, Ill., June 9, 1888.

EDITOR ENGINEERING NEWS:—We intend to put in water-works if we get water from an artesian well which is now being sunk for us, and has already reached a depth of 1,875 ft. We think we can have plenty of water from the well at its present depth, by pumping, but wish a flowing well. If this is not obtained when we have bored through the Potsdam sandstone we will test the well with a deep-well pump. The contractor for the well is J. P. MILLER, of Chicago. The works will cost about $25,000, and our population is 4,000. G. S. DANIELS.

LOSTANT, Ill., June 11, 1888.

EDITOR ENGINEERING NEWS:—A system of water-works costing about $2,000 is now being built by the city and is nearly finished. Water is pumped from a well to a stand-pipe. Our population is 500.
C. P. ADAMS, *Village Clerk.*

MOUNT CARROLL, Ill., June 12, 1888.

EDITOR ENGINEERING NEWS:—The U. S. Wind Engine & Pump Co., of Batavia, Ill., will finish a system of water-works for the city July 4. Water is pumped from a well to a tank by means of a wind engine. The works will cost $18,000, and bonds have been issued to raise money to pay for them. Our population is 2,000. For further information address J. W. MILLER, Mayor.
DON R. FRAZER, *City Clerk.*

PINCKNEYVILLE, Ill., June 12, 1888.

EDITOR ENGINEERING NEWS:—Our population is 1,200 and our present water supply is from wells and cisterns. The city talks of putting in water-works at a cost of $5,000 or $6,000, and the prospects of their doing so are good at present. J. J. BISCHOF can give further information. ED. HAYES.

PRINCETON, Ill., June 11, 1888.

EDITOR ENGINEERING NEWS:—The sum of $5,000 has been appropriated by the city to pay for sinking an artesian well, and the work is now being done by J. P. MILLER, of Chicago. The further details of the water-works have not been decided. Our Mayor, A. H. THOMPSON, may be addressed regarding the works. Our population is 4,000. I. O. BROKAW, *City Clerk.*

ORTONVILLE, Minn., June 11, 1888.

EDITOR ENGINEERING NEWS:—Our population is 1,000 and we now get our water from wells and cisterns. The city has voted $6,000 towards the construction of a $10,000 system of water-works, the supply to be pumped to a tank from Big Stone Lake. P. CLARKE is chairman of the Water Board and H. H. HARRISON our Engineer.
W. C. WHITMAN.

CENTRAL CITY, Neb., June 17, 1888.

EDITOR ENGINEERING NEWS:—The question of issuing bonds for the construction of a $30,000 system of water-works will be voted on soon. We expect work will be started at once. A stand-pipe will be put up and hydrants will be used for fire protection.
WM. PATTERSON, *Mayor.*

LEBANON, Mo., June 11, 1888.

EDITOR ENGINEERING NEWS:—An artesian well has been put down by the Lebanon Water-Works Co. and pumping machinery and a tank erected, but no arrangements have yet been made for pipe, hydrants and other material. The daily capacity of the pump is 100,000 galls. Our company has $10,000 capital stock. M. W. SEEL is President, CHAS. BRANTLEY, Treasurer, and C. C. DRAPER, Secretary. M. W. SEEL.
President, Lebanon Water-Works Company.

DOWNS, Kan., June 11, 1888.

EDITOR ENGINEERING NEWS:—The city has let a contract for water-works to E. SUTPHEN, of Kansas City, Mo. Water is pumped from Wagner wells to a stand-pipe. The works will cost about $30,000, and 6 per cent. bonds, running 30 years, have been issued by the city to pay for same. Our population is between 1,500 and 1,600. The works will be finished in the Fall.
J. M. BAWER, *City Clerk.*

RICHFIELD, Kan., June 12, 1888.

EDITOR ENGINEERING NEWS:—The Richfield Coal, Gas & Water Co., A. T. SPOTSWOOD, President, has begun the construction of a system of water-works, taking the supply from an artesian well and pumping it to a reservoir. The works will cost $25,000, and the capital for their construction has been secured by city bonds and cash payments. The population of Richfield is 1,200. F. F. STEVENS, *Engineer-in-Charge.*

STAFFORD, Kan., June 12, 1888.

EDITOR ENGINEERING NEWS:—A contract for water-works was let last year, but the parties failed to comply with their franchise and nothing has been done since. The proposed supply was from wells. Our population is 1,400. R. PORTER, *City Clerk.*

MORGAN, Tex. June 8, 1888.

EDITOR ENGINEERING NEWS:—We have just completed an artesian well which flows 18 galls. a minute and throws water through a pipe to a height of 40 or 50 ft. We expect to build a large tower or reservoir into which the pressure of the well will carry the water, after this is done we will only need the pipe for mains and services. The well has cost $1,000 and we have $10,000 capital stock. E. WINSTON is Secretary of our company. N. B. RIGGINS,
Prest. Morgan Water-Works & Ice Co.

SPRAGUE, Wash. T., June 10, 1888.

EDITOR ENGINEERING NEWS:—The city is now prospecting for a sufficient and convenient water supply with the idea of putting in works this summer. Water will be pumped from a well to a tank. Our population is 1,800. W. B. LATHMAN, *City Clerk.*

GILMAN, Colo., June 12, 1888.

EDITOR ENGINEERING NEWS:—The Gilman Water Co. will begin to construct water-works Sept. 6 and complete them Nov. 15. The works will cost $5,000. Water will be pumped to a reservoir or tank. GEO. CARVER is President of the company, and A. M. BRYANT can give information concerning the works.
P. A. BOONE.

Annual Reports.

Waterville, N. Y.—The Water Commissioners have issued their report for the year ending May 1, 1888 being the first annual report. The question of a water supply was first taken up in 1886 and an examination was made by W. S. FRANKLIN, C. E. In 1887 the Water Board was organized and W. B. RIDER was appointed engineer. The contract for the work was let to G. W. White, of Pulaski, N. Y.; for pipe to the Warren Foundry & Machine Co., of New York; for specials to Edgerton Bynner, and for valves to the Eddy Valve Mfg. Co. There is a storage reservoir of 20,000,000 galls. capacity; the distributing reservoir will have a capacity of 5,000,000 galls. and will be fed from the the storage reservoir, the water passing through a gravel dike to be filtered. There will be 7 miles of pipe; the mains will be of 16, 12 and 10-in. pipe, and the street mains of 8, 6 and 4-in pipe; every street will be piped. Work is being pushed and it is hoped the works will be completed at an early date. The village has issued bonds for $50,000 at 4 per cent., and sold the bonds at a premium of 2¼ per cent. President, J. D. BRAINERD; Secretary, S. S. BISSELL.

Westfield, Mass.—The Water Commissioners have issued their report for the year ending Feb. 1, 1888. During the year 5,344 ft. of 4-in. pipe were laid, and 8 new Chapman hydrants set; there are now 124 hydrants. The receipts for the year were $14,547.08. The Commissioners are, I. H. PLUMLEY, ELDRIDGE AXTELL and C. M. WHIPPLE.

RECORD OF NEW WATER-WORKS CONSTRUCTION.

(Specially Communicated.)

(CONTINUED FROM PAGE 504).

Vicksburg, Miss.—The works were commenced in February, 1887, and will be completed about July 1, 1888. They were designed by C. DELAFIELD, of New York City, who is also constructing engineer. The contractor is Samuel R. Bullock, of New York; the pumping machinery was furnished by the Deane Steam Pump Co., of Holyoke, Mass.; the pipe and specials by Dennis Long & Co., of Louisville, Ky.; the valves and hydrants by the Ludlow Valve Mfg. Co., of Troy, N. Y., and the stand-pipe by Tippett & Wood, of Phillipsburg, N. J. The supply is to be drawn from the Mississippi river and will be pumped either direct or to a stand-pipe, 145 ft. high by 22 ft. diameter, by 4 compound condensing pumping engines of 4,000,000 galls. daily capacity. There are 14 miles of pipe and 110 hydrants; the mains are of cast-iron and the service pipes of wrought-iron and lead. The annual revenue from city will be $7,000. The works are owned by the Vicksburg Water Supply Co.; President, E. WOLTMANN; Treasurer, J. HOLMES; Secretary, C. M. BERRIAN; Superintendent, C. R. MCFARLAND; capital stock, $250,000; bonds, $250,000; rate of interest, 6 per cent. The franchise is for 30 years. The present population is 15,000.

Loup City, Neb.—The works were commenced Nov. 1, 1887, and completed in May, 1888. They were designed by A. A. RICHARDSON, of Lincoln, Neb., who is now Superintendent; CHAS. SCHROEDER, of Columbus, Neb., was constructing engineer. The contractors were: for masonry, foundations, buildings and reservoir, Ralph Richards, of Loup City; for pumping machinery, Buffalo Steam Pump Co., of Buffalo, N. Y.; for pipe, Chattanooga Pipe Works, of Chattanooga, Tenn., and Ohio Pipe Co., of Columbus, O.; for specials, J. C. Kilner, of York, Neb.; for valves, Galvin Brass & Iron Works, of Detroit, Mich.; for hydrants, Tamaqua Mfg. Co., of Tamaqua, Pa.; the trenching and pipe laying was done under the supervision of Mr. SCHROEDER. The supply is drawn from four 3-in. driven wells and is pumped to a reservoir 46 ft. wide and 12 ft. deep, or can be pumped direct to the mains; the pumping engine has a daily capacity of 250,000 galls. There are 1¼ miles of cast-iron pipe, and 13 hydrants. Ordinary pressure, 40 to 45 lbs; fire pressure, 100 lbs. Cost of works, about $10,000; debt, 6 per cent. The works are owned by the city and are managed by a Board; stock, $8,000. The present population is 1,500.

Bath, N. Y.—In the record of the Bath water-works, on page 482, June 9, it was stated that there are 89 taps. Messrs. BASSETT BROS. inform us that that was the number in use last Fall and that there are now 90 taps, 12 of which are metered. Services are being put in at the rate of over one per day.